PATENT

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Applicant: Nguyen Xuan Nguyen et al.	)	Group Art No.: 2815
Application No: 10/600,521	)	Examiner: Brock II, Paul E
Filed: June 19, 2003	)	Re: **RESPONSE**
For: "A PROCESS FOR FABRICATING . . ."	)	Our Ref: B-3863NP 620845-2/RPB
	)	Date: November 22, 2004

Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

DECLARATION OF PRIOR INVENTION IN THE UNITED STATES TO OVERCOME CITED PATENT OR PUBLICATION (37 CFR 1.131)

1. This declaration is to establish completion of the invention in this application in the United States, at a date prior to June 28, 2001, which is the filing date of United States Patent 6,492,669 to Nakayama.

2. The persons making this declaration are the inventors.

FACTS AND DOCUMENTARY EVIDENCE

3. To establish the date of completion of the invention of this application, the following attached documents are submitted as evidence:

- invention disclosure document
- copies of laboratory notes of the inventors

- statements by the inventors presented herein.

4. The attached invention disclosure document is a true and correct copy of the invention disclosure document completed and signed by each named inventor.

5. The attached invention disclosure document, dated December 22, 1999 and signed by the inventors on December 20, 1999 shows, in section 4 of sheet 2 ("Reduction to Practice") that the present invention was reduced to practice between June 1999 and July 1999. The above time interval is prior to the June 28, 2001 filing date of U.S. Pat. No. 6,492, 669 to Nakayama cited by the USPTO Examiner in the Official Action of June 22, 2004.

6. Evidence of reduction to practice of the invention by July 1999 is also presented, with reference to copies of laboratory notes of the inventors enclosed with the present declaration. Those pages are notes from 1999 taken from the inventors' notebooks with reference to the invention at issue. Those pages are additional evidence that the invention was reduced to practice in June-July 1999, prior to the June 28, 2001 filing date of Nakayama. A subset of the enclosed pages (i.e. pages 1-22) will be commented in detail below.

7. The inventors submit that all claims 1-32 as filed, and thus currently pending process claims 1-16, are directed to inventions that were reduced to practice by July 1999, prior to the June 28, 2001 filing date of Nakayama.

8. A list of currently pending process claims 1-16 is presented in the response to the Action of June 22, 2004 accompanying the present declaration.

9. We submit that a process in accordance with the recitation of claim 1 was reduced to practice by July 1999. With reference to the enclosed notebook papers, the following should be noted:

a) Claim 1 recites a process for fabricating ohmic contacts in a field-effect transistor. Pages 1-5 of the enclosed laboratory notes show an "Ohmic P/R Process" and a "Wafer ID." Pages 6 and 7 of the enclosed laboratory notes recite (top right) a "GaN process." Pages 1-5 of the enclosed laboratory notes refer to processes performed starting on May 10, 1999, June 21, 1999, June 25, 1999, July 8, 1999 and July 13, 1999, respectively. Pages 6 and 7 of the enclosed laboratory notes refer to processes performed between January and February 1999, as also indicated on page 8 of the enclosed laboratory notes .

b) Claim 1 further recites that the process includes a step of thinning the first semiconductor layer forming recessed portions in the semiconductor layer. Pages 9-11 and 13 of the enclosed laboratory notes show an "ohmic recess etch" steps performed on different lots. Note that page 9 of the enclosed laboratory notes recites "ohmic etch 5-14-1999" page 10 of the enclosed laboratory notes recites "ohmic recessed 6-22-99", page 11 of the enclosed laboratory notes recites "ohmic etch 6-30-99", page 12 of the enclosed laboratory notes recites "ohmic etch 7-12-99" . Page 14 of the enclosed laboratory notes shows a step # 10 "Ohmic Recess Etch." The same step is also partially shown in Page 8of the enclosed laboratory notes. The processes performed at pages 6, 14 and 7, 8 of the enclosed laboratory notes have January-February 1999 dates.

Page 15 of the enclosed laboratory notes shows additional experimental data about the etching step. Page 16 of the enclosed laboratory notes shows a diagram relating to etching and data about etching conditions. Page 17 of the enclosed laboratory notes shows comparative diagrams between etching and no etching. Page 18 of the enclosed laboratory notes shows diagrams related to different etching depths.

c) Claim 1 further recites depositing ohmic contacts over the recessed portions. Pages 9-11 and 13 of the enclosed laboratory notes show an "Ohmic metal" step, also specified in page 13 of the enclosed laboratory notes as "Ohmic metal evap."

Page 14 (step # 12) of the enclosed laboratory notes shows an "Ohmic Metallization" step. Pages 9-11 and 13 of the enclosed laboratory notes also show June-July 1999 dates. Page 14 of the enclosed laboratory notes shows January-February 1999 dates.

d) Claim 1 further recites heating the deposited ohmic contacts, whereby, after the heating step, the ohmic contacts communicate with the electron gas. Pages 9-11 and 13 of the enclosed laboratory notes show an "RTA Anneal" step. See also the handwritten notes at page 12 of the enclosed laboratory notes and the last handwritten note at page 13 ("Anneal") of the enclosed laboratory notes .

10. We also submit that a process in accordance with the recitation of claim 2-16 was reduced to practice by July 1999. For example:

a) With reference to claim 2, some of the enclosed pages make reference to GaN semiconductors. See, for example, the top portion of pages 6, 14, 7 and 8 of the enclosed laboratory notes .

b) With reference to claims 3 and 15, some of the enclosed pages make reference to Ti-Al-Ni Au ohmic contacts. See, for example, pages 9-13 of the enclosed laboratory notes .

c) With reference to claim 5, most of the enclosed pages make reference to a reactive ion etching (RIE) process. See, for example, pages 9-13 of the enclosed laboratory notes .

d) With reference to claim 6, most of the enclosed pages make reference to a process employing chlorine (Cl_2). See, for example, pages 9-13 of the enclosed laboratory notes .

e) With reference to claim 7, page 16 of the enclosed laboratory notes represents a diagram with a linear etching function.

f) With reference to claim 11, pages 9-11 and 13 of the enclosed laboratory notes make reference to a heating step performed at 875 ° C.

g) With reference to claim 13, pages 9-11 and 13 of the enclosed laboratory notes make reference to a thinning step performed up to 200 Angstrom.

11. Additional evidence is also shown by the photographs at pages 19-22 of the enclosed laboratory notes. Those photographs are additional evidence not only that a process was performed, but also that a device was built.

12. Additional pages from the inventor's notebooks, not expressly highlighted in the comments above are submitted with the present response. Although these pages have not been commented in detail, they are deemed to be relevant, as additional evidence showing that the invention as claimed in claims 1-16 was reduced to practice.

13. We submit that Nakayama does not claim the same patentable invention of the present application.

14. This declaration is submitted prior to final rejection.

15. As one of the inventors signing below:

I hereby declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like are so made are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code, and that such willful false statements may jeopardize the validity of the application or any patent issued thereon.

SIGNATURES

Inventors:

Full name of first inventor: Nguyen Xuan Nguyen

Inventor's Signature:  Date 11/22/2004

Full name of second inventor: Paul Hashimoto

Inventor's Signature: _____ Date

Full name of third inventor: Chanh Nguyen

Inventor's Signature: _____ Date

15. As one of the inventors signing below:

I hereby declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like are so made are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code, and that such willful false statements may jeopardize the validity of the application or any patent issued thereon.

SIGNATURES

Inventors:

Full name of first inventor: Nguyen Xuan Nguyen

Inventor's Signature: _____ Date

Full name of second inventor: Paul Hashimoto

Inventor's Signature: Paul Hashimoto 19 NOV 2004 Date

Full name of third inventor: Chanh Nguyen

Inventor's Signature: _____ Date

PATENT

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Applicant: Nguyen Xuan Nguyen et al.	Group Art No.: 2815
Application No: 10/600,521	Examiner: Brock II, Paul E
Filed: June 19, 2003	Re: **RESPONSE**
For: "A PROCESS FOR FABRICATING . . . "	Our Ref: B-3863NP 620845-2/RPB
	Date: November 22, 2004

Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

DECLARATION OF UNAVAILABILITY OF INVENTOR

1. My name is Mel Kyle

2. I work for HRL Laboratories, LLC ("HRL") as a paralegal.

3. HRL is the assignee of U.S. Pat. App. 10/600,521 filed on June 19, 2003 and directed to "A process for fabricating ultra-low contact resistances in GaN-based devices."

4. Mr. Chanh Nguyen, one of the inventors of the above application, is no longer an employee of HRL.

5. With reference to the Declaration of Prior Invention under 37 CFR 1.131 to be filed for the above application, I have tried to locate Mr. Chanh Nguyen. According to the last information HRL had on him, Mr. Chanh Nguyen was living at the address listed in the declaration he signed with reference to the present application and was working at GCS located at 23155 Kashiwa Court, Torrance, CA 90505.

6. I tried contacting Mr. Chanh Nguyen regarding the above application and called him at GCS ((310) 530-7274) and learned that he is no longer with GCS.

7. Other people at HRL made phone calls trying to locate Mr. Chanh Nguyen. I have been informed by those people that apparently Mr. Chanh Nguyen is currently in Paris, France taking some time off before he begins a new job, and cannot be reached.

8. Therefore, Mr. Chanh Nguyen is currently unavailable.

I hereby declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like are so made are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code, and that such willful false statements may jeopardize the validity of the application or any patent issued thereon.

Full name: Mel Kyle

Signature: Mel Kyle

Date: 11-19-04

GaN MOD low breakdown voltage

OT 8 Ohmic P/R Process (using 365nm filter on Ch 1)   Date 5-10-99

GaN- Wafer ID: 376, 376 (Flat) 379, 379 (flat)

Danny Wong Version 1   April 12, 1999   HRL PROPRIETARY

5-10-99 pl Make Al foil for edge bead flood expose.   376

5-10-99 pl ACE rinse 30 sec., IPA rinse 30 sec., DI rinse 60 sec., blow dry.   376 flat

-10 pl Drying bake – 100C, 1 min., vac hot plate.

-10 pl Spin on AZ 5214EIR, 3500 rpm, 30 sec. (~1.4 um)   379

-10 pl Dehydration bake – 100C, 1 min., vac hot plate.   379 Flat

-10 pl Edge bead removal – flood expose edge for ~~20~~ 10 sec (clear wafers) @ 20mW/sq.cm., develop 30 sec. in 1:5=351:DI, DI rinse 1 min., blow dry, 376F No tape examine for edge bead removal.

- Insert the 365nm band pass filter into the only open slot inside the optics train in front of the lamp housing. On KSA #1 aligner's power supply, switch to Channel 1. Calibrate the intensity in mWsq.cm. using the handheld OAI meter with the 365nm sensor. The in-control is set at 5.0 mW/sq.cm.

379 F = SEM 2.2 um too reentrant profile
379 NF = probably same → 65 mJ 5/16 strip
~~376 NF~~ ∴ both scalloped sidewall

Note: after usage, remove filter, switch back to Channel 2 and check in-control intensity is at 20.0 mW/sq.cm.

- Image align & expose: ensure proper contact rainbow fringes on sample.
Record contact setting ____________
Use soft contact, align with Power 1 Ohmic mask. Use Channel 1 set up previously.
Expose for ~~16~~ sec (~~80~~ mJ/sq.cm.) typical for clear sample. 75 mJ ~~70 mJ~~ 15 sec
Record expose time 376NF ~70 mJ, 1'10, 15s → side wall straight – SEM CD = 2.1, 2.3.

1(?) pl Post Expose Bake (PEB): on vac hot plate, 100C, 1 min. 10 sec. typical.
Flood expose: on KSA aligner, 1 min. at 20 mW/sq.cm.

1(?) pl Develop in 1:5=351:DI for 20 sec. typical. DI rinse 2 min., blow dry.
Record develop time ____________
Inspect under microscope for rainbow P/R residue inside patterns, take photos.
If needed, additional 5 sec develop, DI rinse 2 min. and blow dry.
Record additional develop time ____________

5 11 pl Take optical microscope photos of CD pattern at different locations. Take SEM photos for straight sidewall profile and 2.0 um S/D spacings at same location areas.

pl LF5 O2 plasma clean: 100W, 2 min., 200mT. RM 99.6

PAGE 1

Ohmic P/R process Version 1 continue

5-14 NXN **Ohmic recess etch: use Cl2 RIE at UCSB. Target ~200A based on test samples at 400A/min rate.**

5-14 NXN **Just prior to sample loading for ohmic metal: 15:1 DI diluted NH4OH for 30 sec dip, DI rinse 1 min., blow dry.**

5-14 NXN **Ohmic metal: use Bay 1 evaporator to deposit Ti-Al-Ni-Au 200-2000-400-500A.**

5-14 NXN **Lify off: ACE soak 15 min. Ultrasonic ACE 1 min. ACE spray 15 sec., clean in ACE 30 sec., IPA clean 30 sec., DI rinse 60 sec., blow dry. Examine for metal residue. Take photos.**

(+) 37 6 NF - much residue @ Ghost of PR pattern of prior ohmic no stripped off completely

- **RTA Anneal at 875C, 30 sec.**
- **Check I-V for 2um S/D spacing on curve tracer.**

ohmic etch

5-14-1999

Ohmic P/R Process (using 365nm filter on Ch 1) | Lot 12 | Date 6/21/99

Wafer ID: 393, ~~394~~, 396, 398

Danny Wong Version 1 April 12, 1999 ERL PROPRIETARY

~~394~~ 404 Recess Gate

* For 396/398, deposit 100A SiN before Ohmic P/R process

*396 SiN 100A before Ohmic P/R process

*398 SiN 100A before Ohmic P/R process

LOT 12

- Make Al foil for edge bead flood expose.
- ACE rinse 30 sec., IPA rinse 30 sec., DI rinse 60 sec., blow dry.
- Drying bake – 100C, 1 min., vac hot plate.
- 100% HMDS : spin at 3500 rpm, 30 sec for 396/398 samples (then AZ 5214 P/R)
- Spin on AZ 5214EIR, 3500 rpm, 30 sec. (~1.4 um) 393 only
- Dehydration bake – 100C, 1 min., vac hot plate. for clear wfr, 70°C, 1 min for opaque wfrs
- Edge bead removal – flood expose edge for ~~20~~ 10 sec @ 20mW/sq.cm., for clear, 5 sec for Opaque develop 30 sec. in 1:5=351:DI, DI rinse 1 min., blow dry, examine for edge bead removal.
- Insert the 365nm band pass filter into the only open slot inside the optics train in front of the lamp housing. On KSA #1 aligner's power supply, switch to Channel 1. Calibrate the intensity in mW/sq.cm. using the handheld OAI meter with the 365nm sensor. The in-control is set at 5.0 mW/sq.cm.

  Note: after usage, remove filter, switch back to Channel 2 and check in-control intensity is at 20.0 mW/sq.cm.
- Image align & expose: ensure proper contact rainbow fringes on sample.
  Record contact setting _____
  Use soft contact, align with Power 1 Ohmic mask. Use Channel 1 set up previously.
  Expose for ~~16~~ 12 sec (~~80~~ mJ/sq.cm.) typical for clear sample. 9sec (45mJ) for Opaque.
  Record expose time 60 _____
- Post Expose Bake (PEB): on vac hot plate, 100C, 1 min. 10 sec. typical. clear [55 sec for opaque]
  Flood expose: on KSA aligner, 1 min. at 20 mW/sq.cm.
- Develop in 1:5=351:DI for ~~20~~ 15 sec. typical. DI rinse 2 min., blow dry.
  Record develop time _____
  Inspect under microscope for rainbow P/R residue inside patterns, take photos.
  If needed, additional 5 sec develop, DI rinse 2 min. and blow dry.
  Record additional develop time _____

PAGE 2

- Take optical microscope photos of CD pattern at different locations. Take SEM photos for straight sidewall profile and ~~2.0~~ 1.9 um S/D spacings at same location areas.
- LF5 O2 plasma clean: 100W, 2 min., 200mT. only on 396, 398 Run 1313
- 100A SiN etch: CF4/O2 RIE in ~~plasma~~ semi-Gronk for 396/398 samples
  BOE dip ~~3~~ (5 sec, DI 2 min, blow dry
- All 4 samples → LCVD @ C1 RIE

Lot#12

Ohmic P/R process Version 1 continue

- 6/22 NKN Ohmic recess etch: use Cl2 RIE at UCSB. Target ~200A based on test samples at 400A/min rate.
- Just prior to sample loading for ohmic metal: 15:1 DI diluted NH4OH for 30 sec dip, DI rinse 1 min., blow dry.
- Ohmic metal: use ~~Bay 4~~ CHA evaporator to deposit Ti-Al-Ni-Au 200-2000-400-500A.

~~[illegible]~~

- 6/22 Lift off: ACE soak 15 min. Ultrasonic ACE 1 min. ACE spray 15 sec., clean in ACE 30 sec., IPA clean 30 sec., DI rinse 60 sec., blow dry. Examine for metal residue. Take photos.

~~[illegible] 393 Liftoff + PRS + scrub dirty residue [illegible]~~

- 6/23 NKN RTA Anneal at 875C, 30 sec.
- 6/25 NKN Check I-V for 2um S/D spacing on curve tracer.

PAGE 10

Ohmic Lift off inspection
393 = ok
346 = many particles some in S-D
398 = Many 2um lifted S-D present
almost all 20 gated devices = lifted

404 - 5048 95 residue in gate
3049 94 " " "
Most residue is NOT in S-D area

6/24-99 ph inspect

6/24/99 PRS 1000 100°C 60' scrub + 5'
∴ resist removed!!!

Beaker process

Lot 12 start 6-21-99
Ohmic recessed 6-22-99

PD 9232AL

Ohmic P/R Process (using 365nm filter on Ch 1) Date 6-25-99

Wafer ID: GaN: 408, 408, 409, 409

Danny Wong Version 1 April 12, 1999 **HRL PROPRIETARY**

LOT 13

Start 6-25-99 pm

6/25 ph Make Al foil for edge bead flood expose.

6-26 pm - PRS1000 50°C @ 15 min, swabs, + 5' PRS → H2O rnse (All 4 wfrs)

6/28 ph ACE rinse 30 sec., IPA rinse 30 sec., DI rinse 60 sec., blow dry.

6/28 ph Drying bake – 100C, 1 min., vac hot plate.

6/28 ph Spin on AZ 5214EIR, 3500 rpm, 30 sec. (~1.4 um)

6/28 ph Dehydration bake – 100C, 1 min., vac hot plate. for clear wfr. 70°C, 1 min for opaque wfrs

6-28 pm Edge bead removal – flood expose edge for ~~20~~ 10 sec @ 20mW/sq.cm., for clear, 5 sec for Opaque
develop 30 sec. in 1:5=351:DI, DI rinse 1 min., blow dry,
examine for edge bead removal.

6/29 NKH Insert the 365nm band pass filter into the only open slot inside the optics train in front of the lamp housing. On KSA #1 aligner's power supply, switch to Channel 1. Calibrate the intensity in mW/sq.cm. using the handheld OAI meter with the 365nm sensor. The in-control is set at 5.0 mW/sq.cm.

Lot 13 #409 Completed Part of Span

Note: after usage, remove filter, switch back to Channel 2 and check in-control intensity is at 20.0 mW/sq.cm.

- Image align & expose: ensure proper contact rainbow fringes on sample.
  Record contact setting _____
  Use soft contact, align with Power 1 Ohmic mask. Use Channel 1 set up previously.
  Expose for ~~16~~ 12 sec (~~80~~ 60 mJ/sq.cm.) typical for clear sample. 9sec (45mJ) for opaque.
  Record expose time _____

- Post Expose Bake (PEB): on vac hot plate, 100C, 1 min. 10 sec. typical. clear. 55sec for opaque
  Flood expose: on KSA aligner, 1 min. at 20 mW/sq.cm.

- Develop in 1:5=351:DI for ~~20~~ 15 sec. typical. DI rinse 2 min., blow dry.
  Record develop time _____
  Inspect under microscope for rainbow P/R residue inside patterns, take photos.
  If needed, additional 5 sec develop, DI rinse 2 min. and blow dry.
  Record additional develop time _____

- Take optical microscope photos of CD pattern at different locations. Take SEM photos for straight sidewall profile and ~~2.0~~ 1.9 um S/D spacings at same location areas.

6/24 ph LF5 O2 plasma clean: 100W, 2 min., 200mT.

6/30 ph - RCA for cl etch

PAGE 3

1 of 13

Ohmic P/R process Version 1 continue

6/30 Ohmic recess etch: use Cl2 RIE at UCSB. Target ~200A based on test samples at 400A/min rate.

- Just prior to sample loading for ohmic metal: 15:1 DI diluted NH4OH for 30 sec dip, DI rinse 1 min., blow dry.

-1 NCP Ohmic metal: use Bay 4 evaporator to deposit Ti-Al-Ni-Au 200-2000-400-500A.

-1 after Liftoff: ACE soak 15 min. Ultrasonic ACE 1 min. ACE spray 15 sec., clean in ACE 30 sec., IPA clean 30 sec., DI rinse 60 sec., blow dry. Examine for metal residue. Take photos.

1-99 NCP RTA Anneal at 875C, 30 sec.

- Check I-V for 2um S/D spacing on curve tracer.

1-96 Ohmic 9 of 8 Flat - PR residue in well S-D very clean
All 9 have PR residue in S-D

1-99 Beaker process PRS 1000 100°C
10' g scrub + 5', Rinse H_2O, IPA, Aceton, IPA

Ohmic etch 6-30-99

Ohmic P/R Process (using 365nm filter on Ch 1) ← mesa etch ico
Wafer ID: GaN hostwt/4|4, GaN 4|4 nf = mina fwd Date 7-8-99
Danny Wong Version 1 April 12, 1999 HRL PROPRIETARY

LOT#
SiC 14
① GaN mesa
② GaN mina fwd

7-8-99 ph Make Al foil for edge bead flood expose.
7-8-99 PRS1000 50°C pre clean 15 + swab + 5, 1 to rinse

7/8 ph ACE rinse 30 sec., IPA rinse 30 sec., DI rinse 60 sec., blow dry.

7/8 ph Drying bake – 100C, 1 min., vac hot plate.

7/8 ph Spin on AZ 5214EIR, 3500 rpm, 30 sec. (~1.4 um)

7/8 ph Dehydration bake – 100C, 1 min., vac hot plate. for clear wfr, 70°C, 1 min for opaque wfrs

7/8 ph Edge bead removal – flood expose edge for ~~20~~ 10 sec @ 20mW/sq.cm., for clear, 5 sec for Opaque
develop 30 sec. in 1:5=351:DI, DI rinse 1 min., blow dry,
examine for edge bead removal.

7/8 ph Insert the 365nm band pass filter into the only open slot inside the optics train in front of the lamp housing. On KSA #1 aligner's power supply, switch to Channel 1. Calibrate the intensity in mW/sq.cm. using the handheld OAI meter with the 365nm sensor. The in-control is set at 5.0 mW/sq.cm.

4|4 NF = 570 contact

Lot 14
4|4
Complete
for
Post Spin

Note: after usage, remove filter, switch back to Channel 2 and check in-control intensity is at 20.0 mW/sq.cm.

7/8 ph Image align & expose: ensure proper contact rainbow fringes on sample.
Record contact setting 570, 560
Use soft contact, align with Power 1 Ohmic mask. Use Channel 1 set up previously.
Expose for ~~16~~ 12 sec (~~80~~ mJ/sq.cm.) typical for clear sample. 9sec (45mJ) for Opaque.
Record expose time 60

7/8 ph Post Expose Bake (PEB): on vac hot plate, 100C, 1 min. 10 sec. typical. clear. 55sec for opaque
Flood expose: on KSA aligner, 1 min. at 20 mW/sq.cm.

7/8 ph Develop in 1:5=351:DI for ~~20~~ 15 sec. typical. DI rinse 2 min., blow dry.
Record develop time
Inspect under microscope for rainbow P/R residue inside patterns, take photos.
If needed, additional 5 sec develop, DI rinse 2 min. and blow dry.
Record additional develop time

PAGE 4

7/8 ph Take optical microscope photos of CD pattern at different locations. Take SEM photos for straight sidewall profile and 2.0 ~~um~~ 1.9 S/D spacings at same location areas.

7/8 ph LF5 O2 plasma clean: 100W, 2 min., 200mT. Run # 1463

13 pages

7-12-99 ph - Both wafers back from UCSB Cl⁻ RIE
CHA not available till 7/13/99 1:00 PM

7/ - CHA evap. Ti, Al, Ni Au

7/ - Lift off Acetone 15' + Spray + 5-10', IPA

7- - In spec't

7- - Anneal ohmics

Ohmics etch 7-12-99 ?

Ohmic P/R Process (using 365nm filter on Ch 1) + GaN 419 No Flat

Wafer ID: GaN 415 NF, GaN 415 F, WT 990409A1 (½ wafer) **Date** 7-13-99

Danny Wong Version 1 **April 12, 1999** **HRL PROPRIETARY**

7-13 dw Make Al foil for edge bead flood expose.

7-13 dw ACE rinse 30 sec., IPA rinse 30 sec., DI rinse 60 sec., blow dry.

7-13 dw Drying bake – 100C, 1 min., vac hot plate.

7-13 dw Spin on AZ 5214EIR, 3500 rpm, 30 sec. (~1.4 um)

7/13 dw Dehydration bake – 100C, 1 min., vac hot plate.

7-13 dw Edge bead removal – flood expose edge for ~~20~~ 10 sec @ 20mW/sq.cm., develop 30 sec. in 1:5=351:DI, DI rinse 1 min., blow dry, examine for edge bead removal.

13-dw Insert the 365nm band pass filter into the only open slot inside the optics train in front of the lamp housing. On KSA #1 aligner's power supply, switch to Channel 1. Calibrate the intensity in mW/sq.cm using the handheld OAI meter with the 365nm sensor. The in-control is set at 5.0 mW/sq.cm.

Note: after usage, remove filter, switch back to Channel 2 and check in-control intensity is at 20.0 mW/sq.cm.

13 dw Image align & expose: ensure proper contact rainbow fringes on sample.
Record contact setting _____
Use soft contact, align with Power 1 Ohmic mask. Use Channel 1 set up previously.
Expose for ~~16~~ 12 sec (~~20~~ mJ/sq.cm.) typical for clear samples.
Record expose time 60

13 dw Post Expose Bake (PEB): on vac hot plate, 100C, 1 min. 10 sec. typical.
Flood expose: on KSA aligner, 1 min. at 20 mW/sq.cm.

13 dw Develop in 1:5=351:DI for ~~20~~ 15 sec. typical. DI rinse 2 min., blow dry.
Record develop time _____
Inspect under microscope for rainbow P/R residue inside patterns, take photos.
If needed, additional 5 sec develop, DI rinse 2 min. and blow dry.
Record additional develop time _____

3 dw Take optical microscope photos of CD pattern at different locations. Take SEM photos for straight sidewall profile and 2.0 um S/D spacings at same location areas.

WT = 95% of 2 um = lifted a ~~bit~~ sheet → strip on 7/14
WT: 2nd time = also poor adhesion WT: 3rd time strip poor adhesion

14 dw LFS O2 plasma clean: 100W, 2 min., 200mT.

2 wafers 415F Run 1507 100W, 2'

1/99 ph WT 990409A1 & GaN419 NoFlat & Either Ohmic PR spun + exposed successfully NXN (Ohmic 4th time) PR

Dehydration Bake = 1'+1'+2'

1/21/99 ph LFS Run 1576 2' 100W

2/99 NXN - Ohmic PR, Expose on GaN420 = Done

PCB 1'13'
415F 65mJ
415NF 55mJ 1'10'
WT 45 55'

PAGES

Ohmic P/R process Version 1 continue

7-14 NXN - Ohmic recess etch: use Cl2 RIE at UCSB. Target ~200A based on test samples at 400A/min rate.

- Just prior to sample loading for ohmic metal: 15:1 DI diluted NH4OH for 30 sec dip, DI rinse 1 min., blow dry.

Lot 15

1/6 NXN Ohmic metal: use Bay 4 evaporator to deposit Ti-Al-Ni-Au 200-2000-400-500A.

1/6 NXN Lift off: ACE soak 15 min. Ultrasonic ACE 1 min. ACE spray 15 sec., clean in ACE 30 sec., IPA clean 30 sec., DI rinse 60 sec., blow dry. Examine for metal residue. Take photos. 415 Flat cracked → sof
415 Both are much!! residue on ohmic

1/14/99 NXN 415 F - RTA Anneal at 875C, 30 sec.

1/16/99 NXN 415 F - Check I-V for 2um S/D spacing on curve tracer.

2/6/99 BH Ohmic metal evap ≈ 3.7×10^{-7} process #5

WT 990409 AI
GaN 419
GaN 420

Parameter Film #	2	5	3	6
layer #	①	②	③	④
thickness	300 Å	2,000	400	500
metal	Ti	Al	Ni	Au
	rate incorrect so Dep. stopped at resistive thickness 317 Å			

PAGE 13

7/24/99 Lift off Acetone 15+5', ~~PRS1000 100°C~~ u/s 2', PRS 1000 100°C,
3 wafers ✓
WT = clean
419 = numerous specks on ohmic metal. Also fine scratches.
420 = less " " " " less " "

1/27/99 Anneal
BH 3 wafers WT, 419, 420

LOT #: 3 Wafer ID: NRL 319 NMD 448, 449 GaN Process OS

	Step #	Process	OSQR	DATE	SIG	Instructions
		OHMIC				
	1	Blanket Expose Al Foil Pattern	3	1/27/99	ph	Trace wafer outline with dots on Al foil using exacto knife, then retrace outline ~2mm undersize all around. Cut and trim undersized outline with scissors. If needed, flatten trimmed Al foil pattern between two glass plates. Try pattern on wafer for exposed edge fit, trim if needed. Put Al foil on round wafer carrier so that it sticks to the underside of the carrier cap for use. Put Sapphire with epi side face down on carrier. Measure Sapphire thickness on dial gauge _____ um
	2	Solvent Clean	3	1/27/99	ph	ACE 30 sec., IPA 30 sec., DI rinse 60 sec. N_2 blow dry.
	3	P/R Coat	3	1/27/99	ph	Pre-bake on vacuum hot plate, 100C, 1 min. Spin AZ 5214EIR @ 3500RPM, 30 sec. (~1.4um) Soft bake on vacuum hot plate, 100C, 1 min.
	4	Edge Bead Removal	3	1/27/99	ph	Put trimmed Al foil over wafer with edge exposed. Flood expose edges for 20 sec @ 20mW/sq.cm. on KSA aligner using soft contact. Develop for 30 sec. In 1:5=AZ351:DI DI rinse 1 min., N_2 blow dry.
	5	Ohmic Mask Align & Expose (Contact) original setting = 6.4 44	3	1/28/99	ph	Power 1 Ohmic Mask Use Soft Contact mode on KSA Aligner #1 Put dark electrical tape on wafer chuck, put Sapphire sample on top of tape. Orient it so that S-D channel will be parallel to straight edge of sample. Adjust separation dial for proper contact rainbow fringes on sample. Adjust sample so that e-beam gate markers are near sample corners with 2-3 pattern reticles included. Expose 2.9 sec. typ.for clear sample 2.7 sec typ. For dull sample (20mW/sq.cm.) Sample # Exposure time ------- --------- ------- ---------
	6	Image Reversal	3	1/28/99	ph	Post Expose Bake (PEB): On vac hot plate, 100C, 1 min. Flood Expose: On KSA aligner. 1 min. @ 20mW/sq.cm.
	7	Develop	3	1/28/99	ph	AZ351 : H_2O = 1:5 for 15 sec. 1 min. DI rinse, N_2 blow dry.

PAGE 6

	Step #	Process	OSQR	DATE	SIG	Instructions
		OHMIC continue				
	8	Inspect 448 = OK 449 = OK 319 = Dirty resist - poor contact 449 = poor contact Reworked 319 2nd litho = track resist resist stick to mask CD = 1 - 1.2 um	3	1/28	M	Optical microscope: Inspect for proper pattern expose & develop. Rough measure of 2um S-D CD using measure reticle. Take photos. SEM: Take photos of patterns and P/R sidewall profiles. Accurate measure 2um S-D CD.
	9	O_2 Plasma Clean				LF5 100W, 200mT, 2 min. Run #_____
	10	Ohmic Recess Etch				At UCSB using Cl_2 RIE Target ~ 200A based on test samples Record: recess etch _____A CL_2 RIE conditions:
	11	Pre-Metal Clean				Just prior to loading $NH_4OH : H_2O$ = 1:15, 30 sec. 1 min. DI rinse, N_2 blow dry.
	12	Ohmic Metallization				Use Bay 1 evaporator Ti – Al – Ni – Au 200 – 2000 – 400 – 500A
	13 449 & 448 mixed up bath = bad ?	Lift-Off All = very difficult lift off up 2 to 2 < 2 min. 319 = metal ribbon fall onto all devices * all devices metal at S-D	3 4	2/28		ACE soak 15 min. Ultrasonic ACE 1 min. ACE spray 15 sec., clean in ACE 30 sec., IPA 30 sec., DI 60 sec., N2 bow dry. Examine for P/R residues. If needed, use Automated lift off bath with PRS-1000 @ 100C, 60 min. 120 min. max. w/ 10 min. additional increments Record time _____ DI water spray 15 sec. DI rinse 2 min., N_2 blow dry.
	14	Inspect				Optical microscope to inspect for P/R residues Take photos. Comment:
	15	Anneal				RTA anneal @ 875C, 30 sec.
	16	I-V Check				On curve tracer, check I-V for 2um spacing. Take photos.

PAGE 16

LOT #: 3 Wafer ID: HRL 319 NMD 448, 449 GaN Process OS

	Step #	Process	OSQR	DATE	SIG	Instructions
		OHMIC				
	1	Blanket Expose Al Foil Pattern	3	1/27/99	ph	Trace wafer outline with dots on Al foil using exacto knife, then retrace outline ~2mm undersize all around. Cut and trim undersized outline with scissors. If needed, flatten trimmed Al foil pattern between two glass plates. Try pattern on wafer for exposed edge fit, trim if needed. Put Al foil on round wafer carrier so that it sticks to the underside of the carrier cap for use. Put Sapphire with epi side face down on carrier. Measure Sapphire thickness on dial gauge _____ um
	2	Solvent Clean	3	1/27/99	ph	ACE 30 sec., IPA 30 sec., DI rinse 60 sec. N_2 blow dry.
	3	P/R Coat	3	1/27/99	ph	Pre-bake on vacuum hot plate, 100C, 1 min. Spin AZ 5214EIR @ 3500RPM, 30 sec. (~1.4um) Soft bake on vacuum hot plate, 100C, 1 min.
	4	Edge Bead Removal	3	1/27/99	ph	Put trimmed Al foil over wafer with edge exposed. Flood expose edges for 20 sec @ 20mW/sq.cm. on KSA aligner using soft contact. Develop for 30 sec. In 1:5=AZ351:DI DI rinse 1 min., N_2 blow dry.
	5	Ohmic Mask Align & Expose (Contact) Original Setting = 6.4 44	3	1/28/99	ph	Power 1 Ohmic Mask Use Soft Contact mode on KSA Aligner #1 Put dark electrical tape on wafer chuck, put Sapphire sample on top of tape. Orient it so that S-D channel will be parallel to straight edge of sample. Adjust separation dial for proper contact rainbow fringes on sample. Adjust sample so that e-beam gate markers are near sample corners with 2-3 pattern reticles included. Expose 2.9 sec. typ.for clear sample 2.7 sec typ. For dull sample (20mW/sq.cm.) Sample # Exposure time -------- ---------- -------- ----------
	6	Image Reversal	3	1/28/99	ph	Post Expose Bake (PEB): On vac hot plate, 100C, 1 min. Flood Expose: On KSA aligner, 1 min. @ 20mW/sq.cm.
	7	Develop	3	1/28/99	ph	AZ351 : H_2O = 1:5 for 15 sec. 1 min. DI rinse, N_2 blow dry.

PAGE 7

RCE: HRL)

	Step #	Process	OSQR	DATE	SIG	Instructions
		OHMIC continue				
	8	Inspect 448 = OK 449 = OK 319 = Dirty resist - poor contact 449 = poor contact Reworked 319 2nd litho = crack resist resist stick to mask CD = 1 - 1.2um	3	1/28	M	Optical microscope: Inspect for proper pattern expose & develop. Rough measure of 2um S-D CD using measure reticle. Take photos. SEM: Take photos of patterns and P/R sidewall profiles. Accurate measure 2um S-D CD.
	9	O_2 Pl				
	10	Ohmi				st samples __A
	11	Pre-M				c. y.
	12	Ohmic				
	13	Lift-Off All = very difficult lift off up 2+2+2 min. 319 = metal ribbon fall onto all devices all devices exist at S-D 449 & mixed up bath = bad	3	2/28	M	ACE soak 15 min. Ultrasonic ACE 1 min. ACE spray 15 sec., clean in ACE 30 sec., IPA 30 sec., DI 60 sec., N2 bow dry. Examine for P/R residues. If needed, use Automated lift off bath with PRS-1000 @ 100C, 60 min. 120 min. max. w/ 10 min. additional increments Record time _____ DI water spray 15 sec. DI rinse 2 min., N_2 blow dry.
	14	Inspect				Optical microscope to inspect for P/R residues Take photos. Comment:
	15	Anneal				RTA anneal @ 875C, 30 sec.
	16	I-V Check				On curve tracer, check I-V for 2um spacing. Take photos.

Ohmic recess etch

Jan OR Feb. 1999

PAGE 8

LABORATORY NOTEBOOK

Notebook No.: 5007

Assigned to: Nguyen X. Nguyen

Date: 12/18/97

Etching Experiment with Cl_2 ECR System:

⇒ First trial: 200 W / 4 mT / 10 sccm → ~700 Å/min.

100 W / 4 mT / 10 sccm → 350 Å/min.
300 W / 4 mT / 10 sccm → Unstable plasma, no reliable data.
400 W " " → " " "

200 W w/ Vary Pressure.

			2 min Etch
4 mT	(Top Mag Only)	Unstable → Stable	3245 Å
6 mT	(Top Mag Only)	Stable	3095 Å
8 mT	(Both Magnet)	Unstable → Stable	No data
10 mT	(Both Magnet)	Stable	200 → 300 Å.

250 W → 4 mT No Run (Power shut off)

250 W → 8 mT

Recent etch data:

200 W w/ 4 mT. Top mag only → ~1,000 Å (twice)

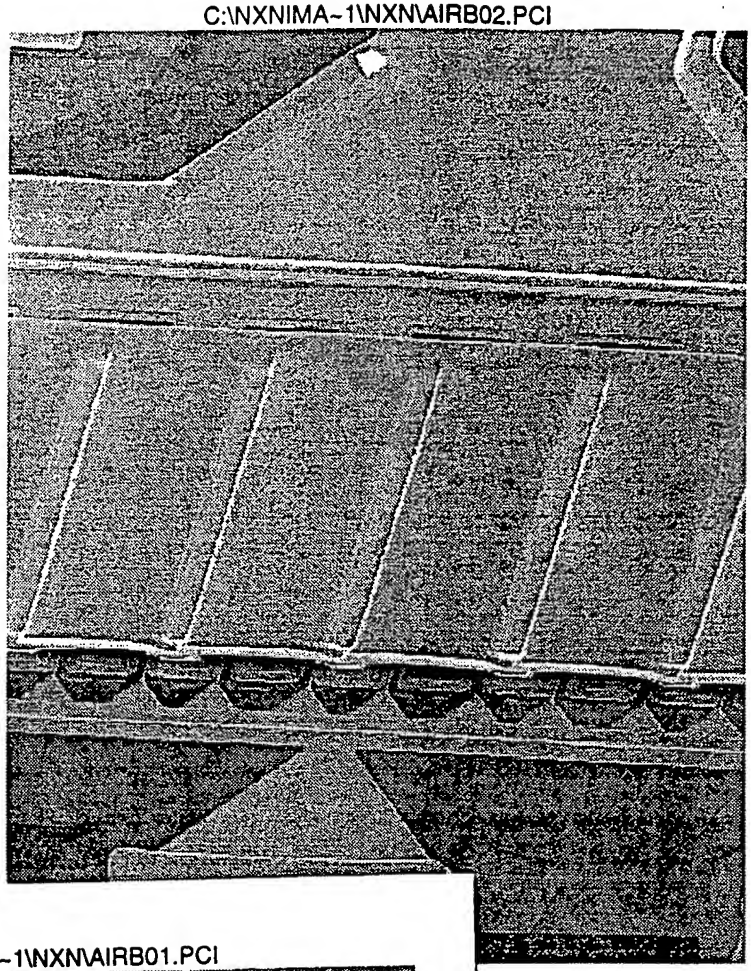
PAGE 15

Continued on Page

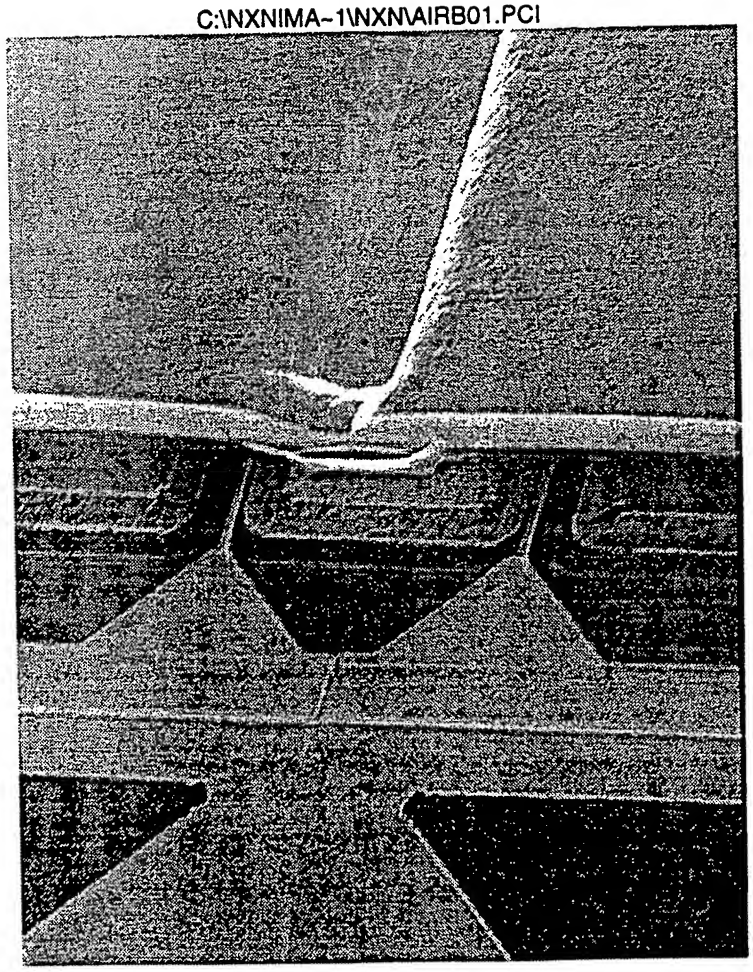
Read and Understood By

12 pages

C:\NXNIMA~1\NXN\AIRB02.PCI



C:\NXNIMA~1\NXN\AIRB01.PCI



PAGE 19

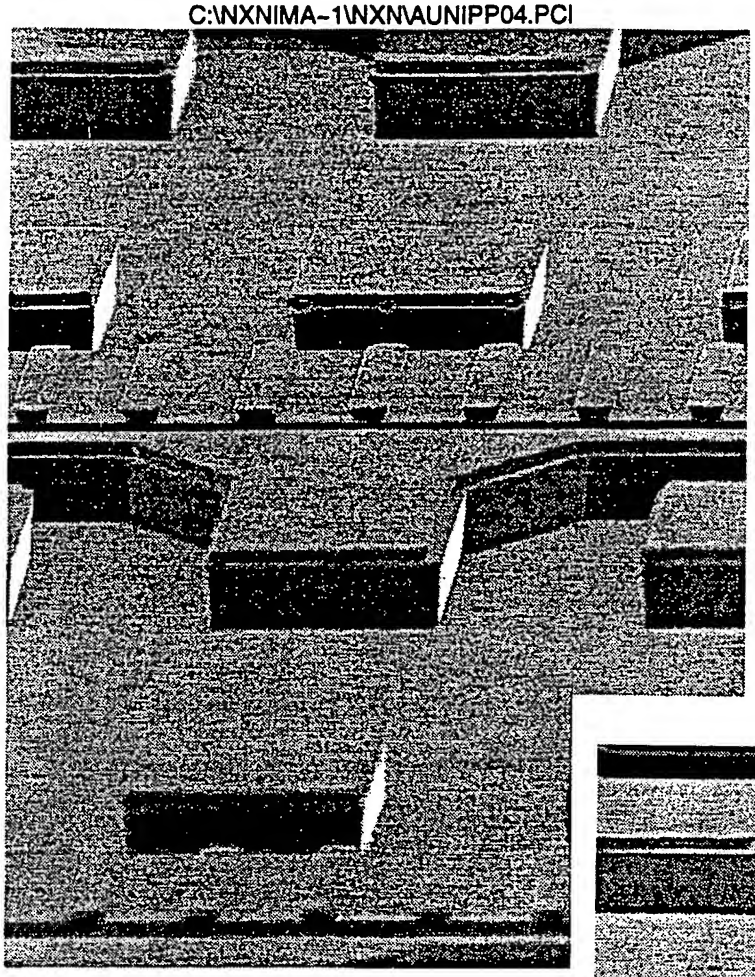
Continued on Page

nd Understood By

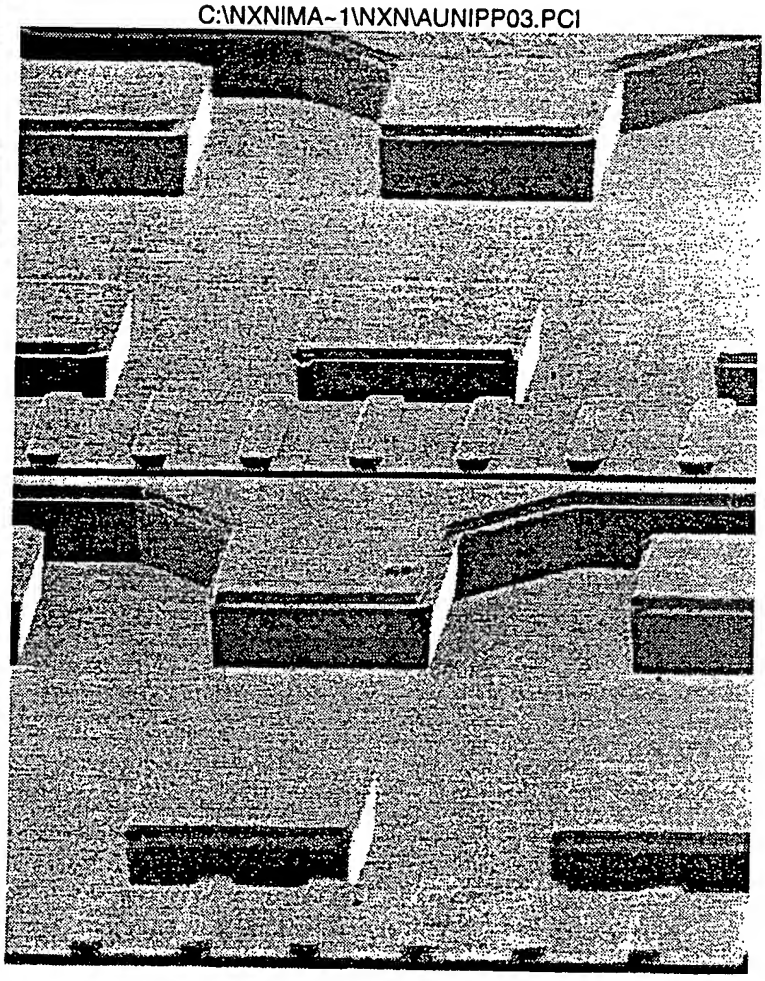
Signed

Date

C:\NXNIMA~1\NXN\AUNIPP04.PCI

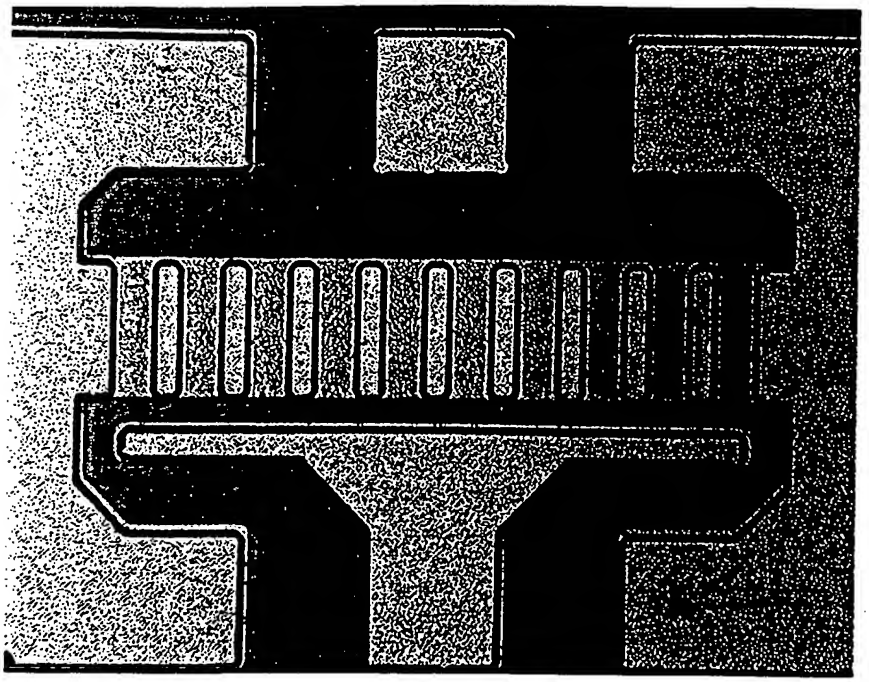


C:\NXNIMA~1\NXN\AUNIPP03.PCI

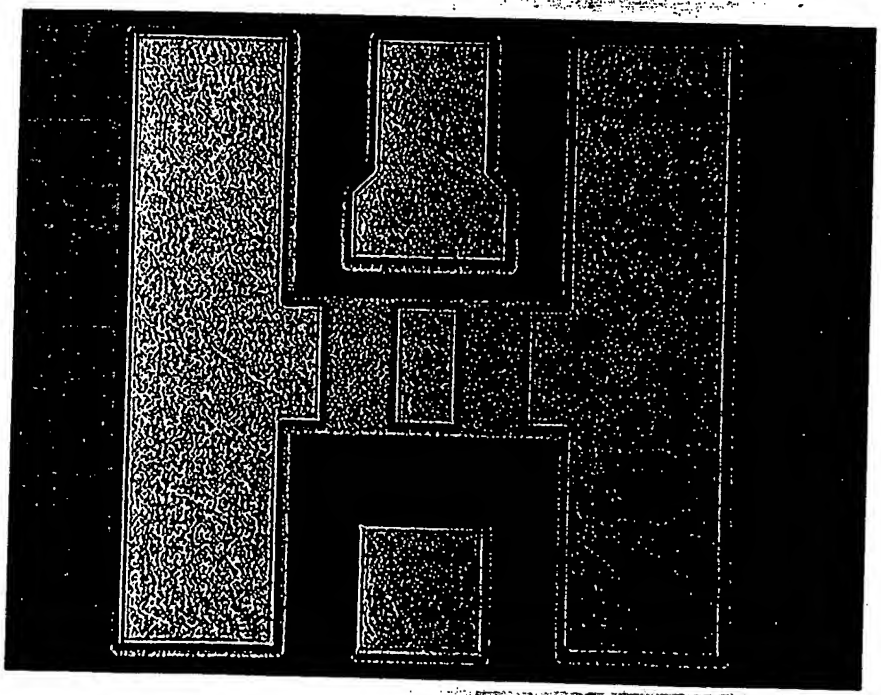


Read and Understood By:

Signed _____ Date _____



PAGE 2



Continued on Page ...

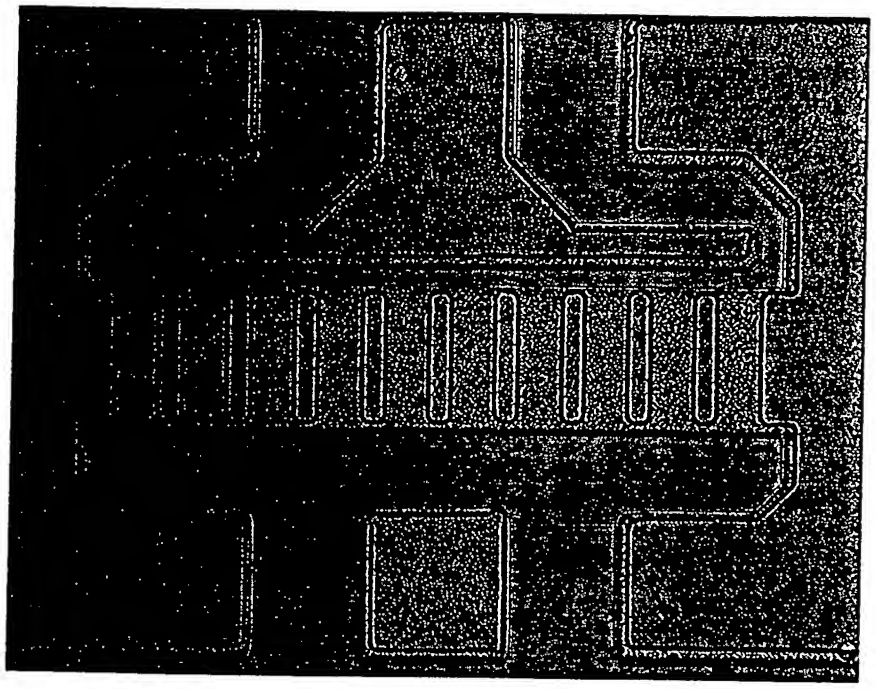
Read and Understood By

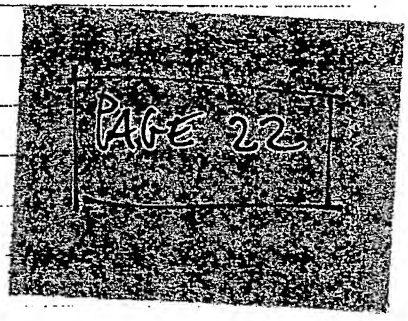
Signed ... Date ... Signed ... Date

PROJECT _____

Notebook No. _____

Continued From Page _____





Continued on Page

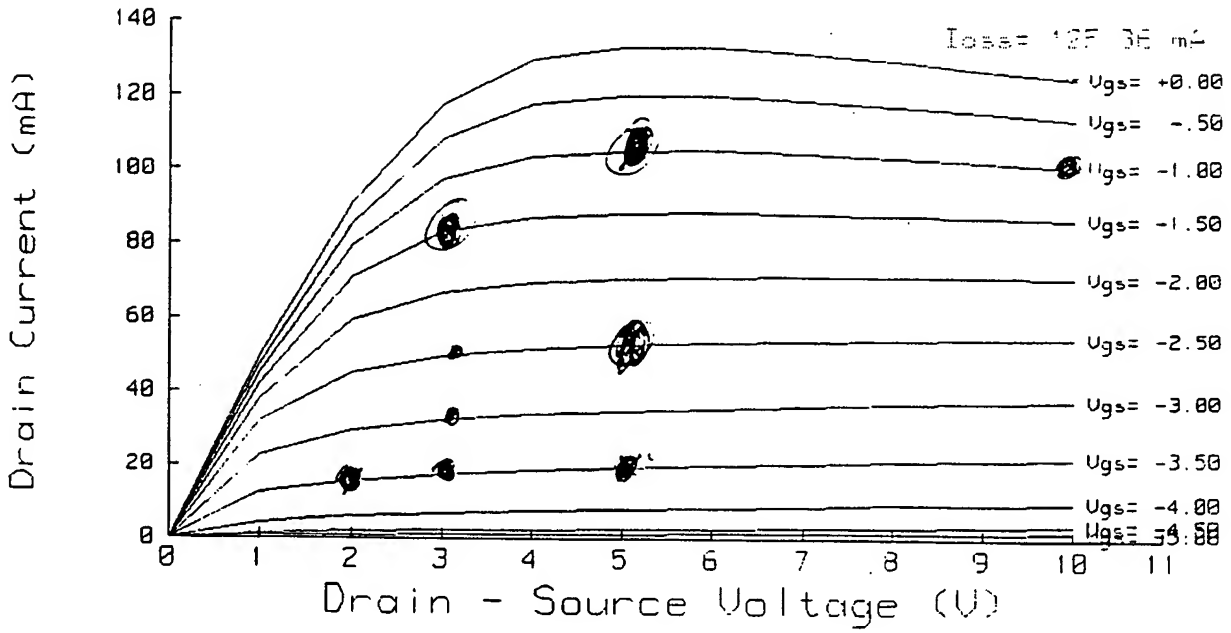
Read and Understood By

Noise measurement w/ P. Harvey.

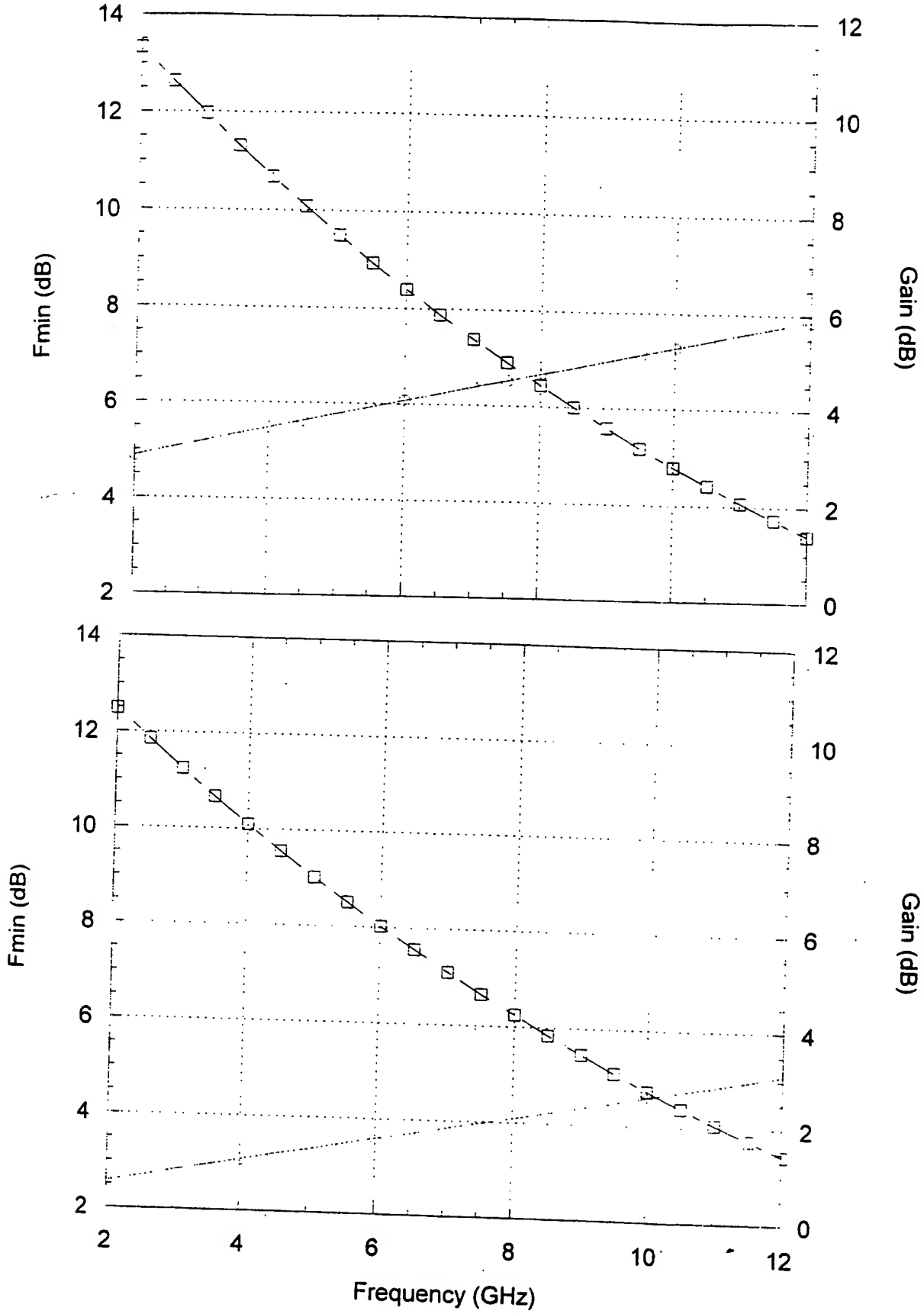
Gen 253 - gn0190301 - 505!-9C $V_{ds} = 10V$; $V_g = -1.0V$

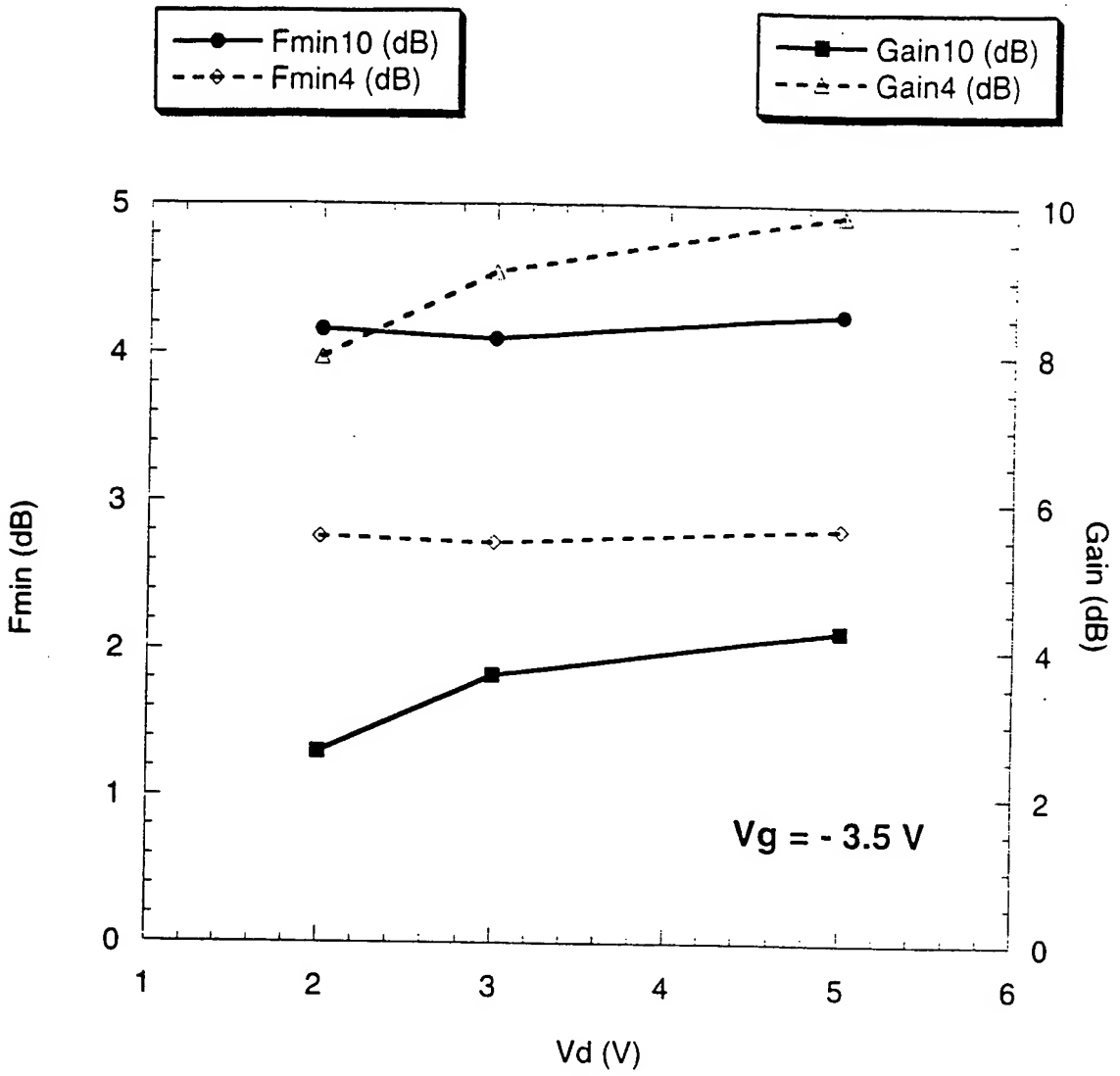
gn0190325 - $V_{ds} = 3V$; $V_g = -2.5V$

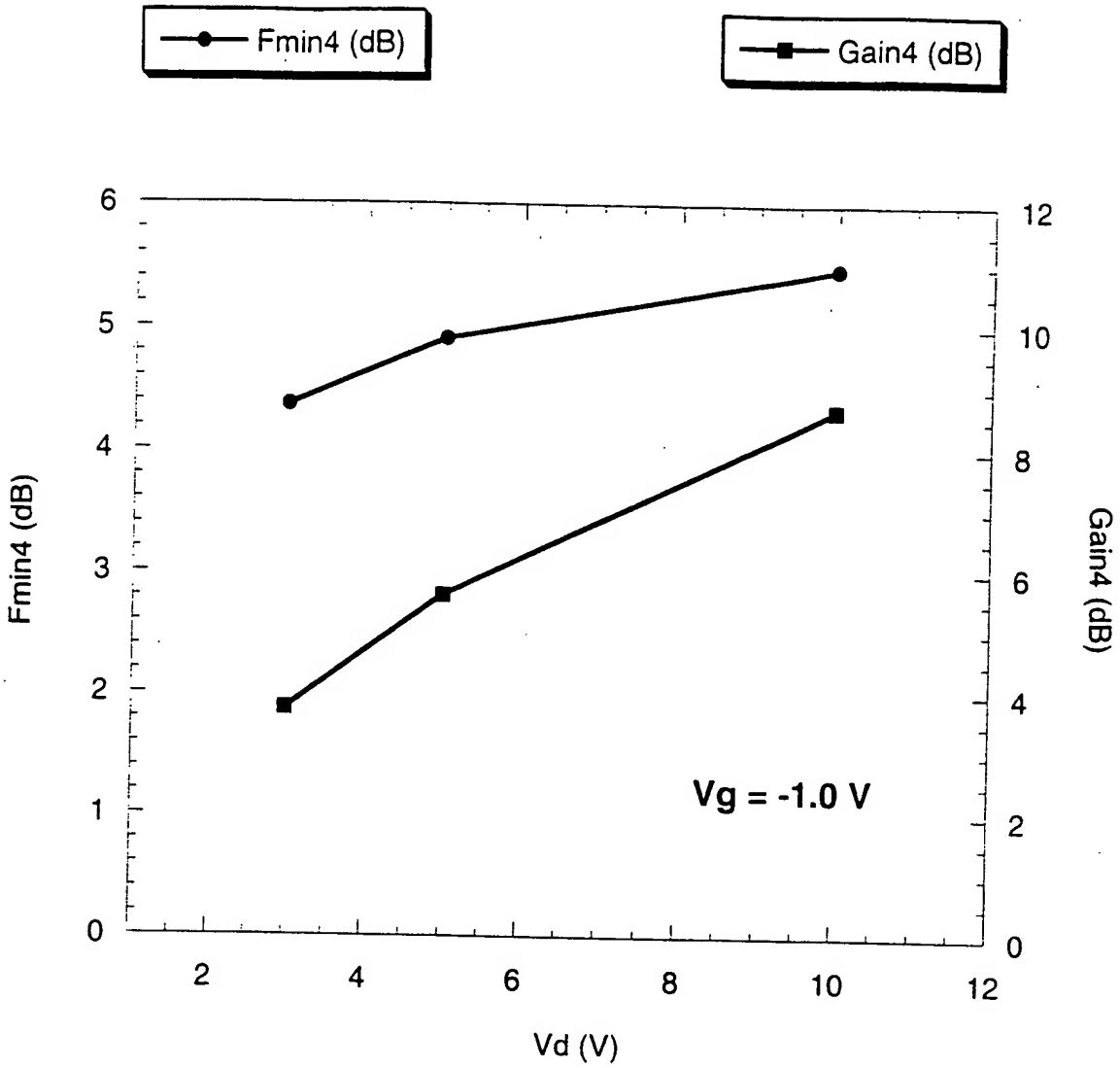
DRAIN CURRENT vs. DRAIN-SOURCE VOLTAGE

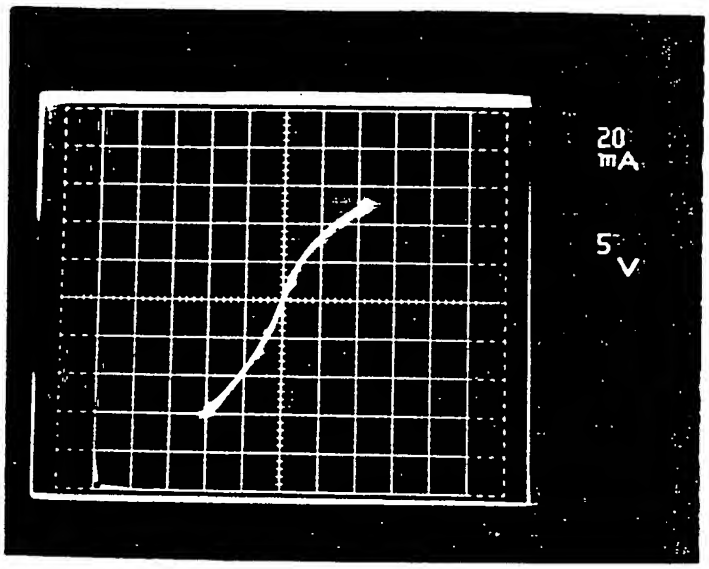


Signed Date Date


Fmin (dB)
Gain (dB)
Frequency (GHz)
14
12
10
8
6
4
2
0
2
4
6
8
10
12


Fmin10 (dB)
Fmin4 (dB)
Gain10 (dB)
Gain4 (dB)
Fmin (dB)
Gain (dB)
Vd (V)
Vg = - 3.5 V
0
1
2
3
4
5
6
0
2
4
6
8
10
1
2
3
4
5
6

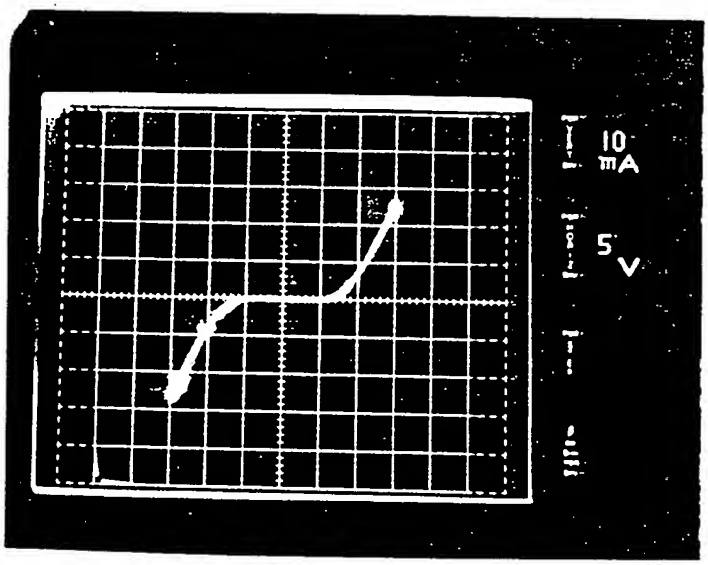

Fmin4 (dB)
Gain4 (dB)
6
5
4
3
2
1
0
12
10
8
6
4
2
0
2
4
6
8
10
12
Vd (V)
Vg = -1.0 V



Prior to annealing

After metal deposition

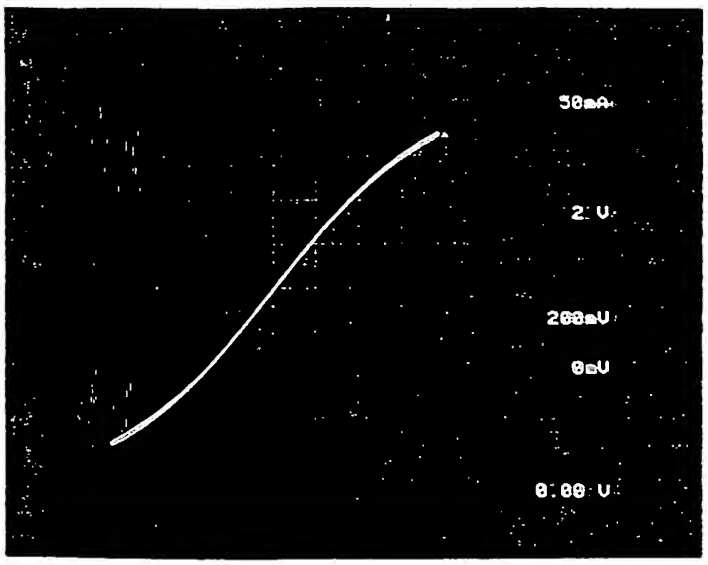
Cell 283

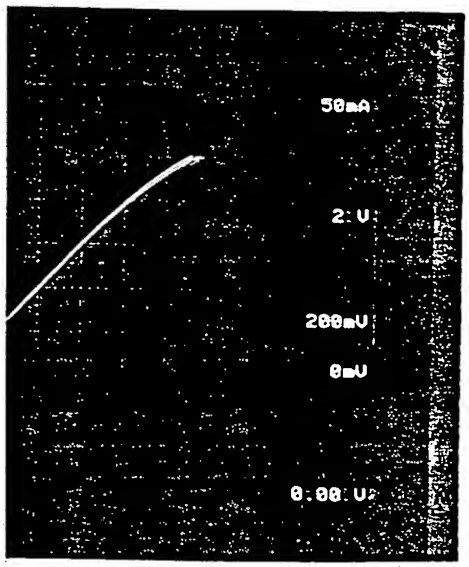


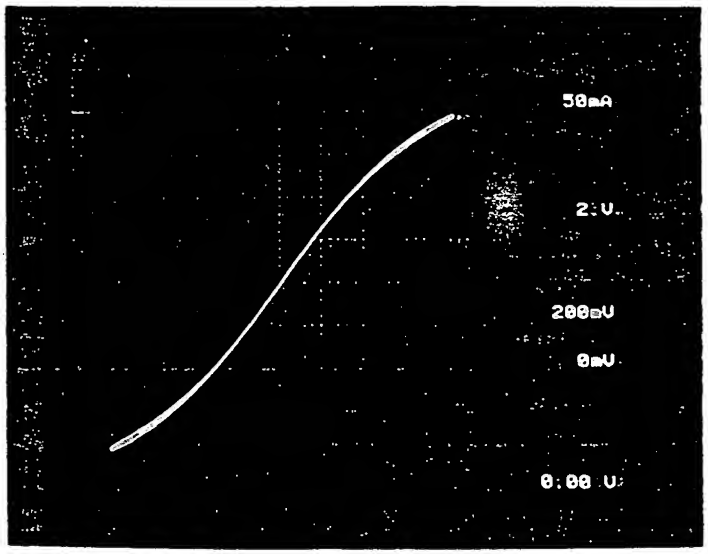
Cell 285.

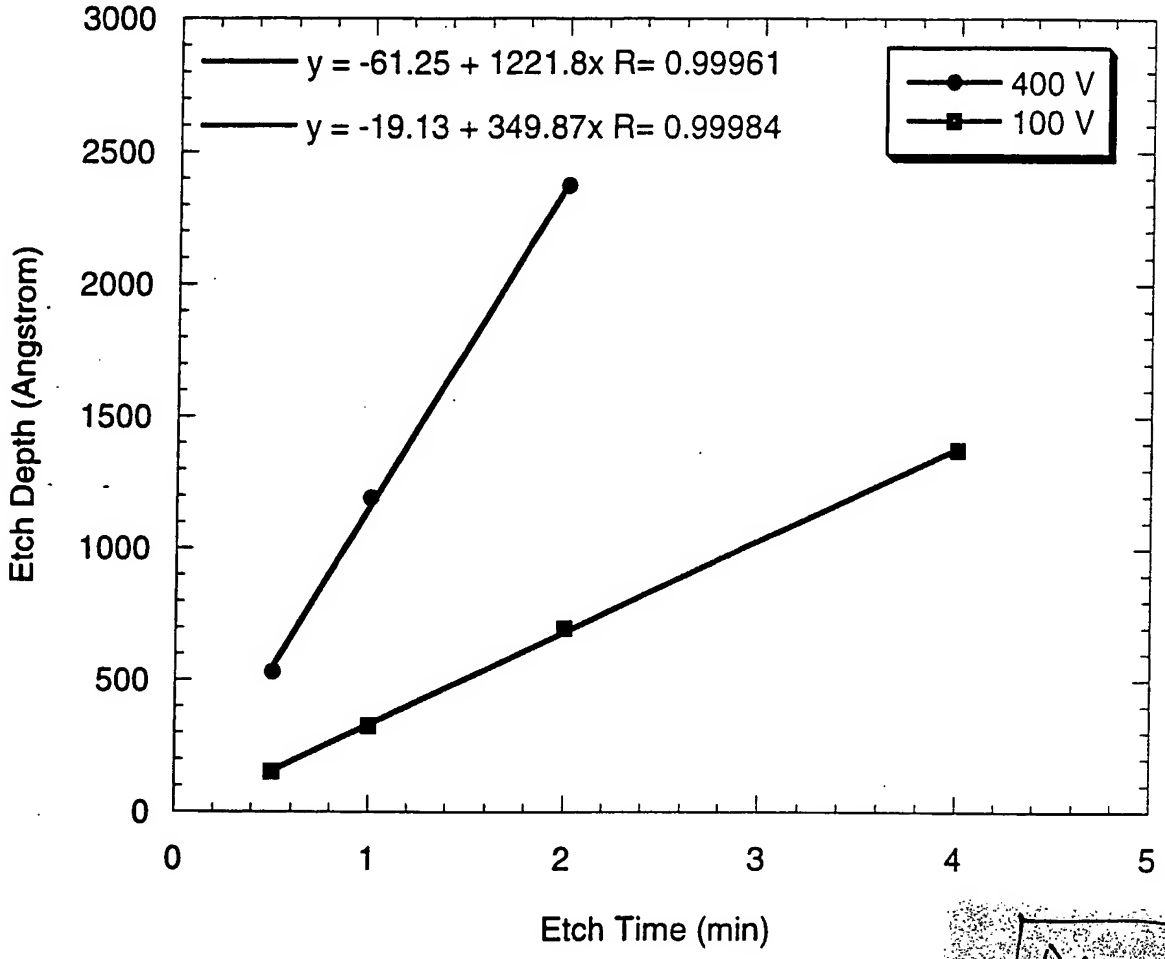
Signed

Date


50mA
2:U
200mU
0mU
0:00 U


50mA
2:U
200mU
0mU
0:00 U


50mA
2:U
200mU
0mU
0:00 U



PAGE 16

Etching conditions:

Base Pressure : $4-5 \times 10^{-6}$ T

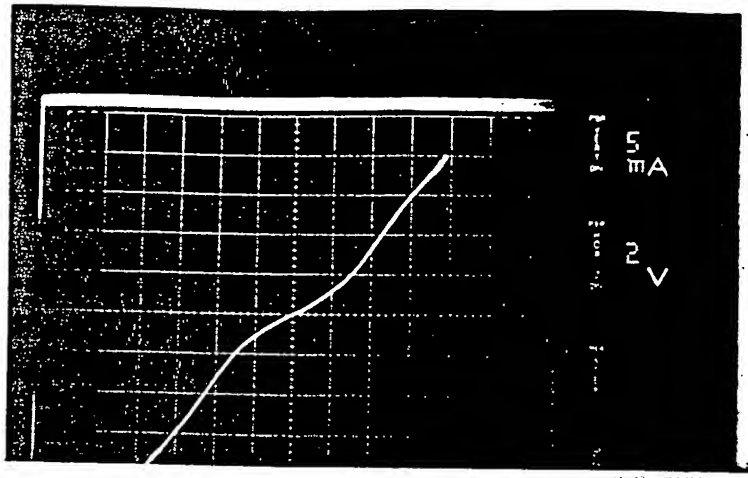
Cl_2 Flow ; 18 sccm.

Chamber Press. : 5 mT.

Power @ 400V - 185-191 W ; $P_{reflected}$ - 5 W.
@ 100V - 44-47 W ; P_r ~ 0 W.

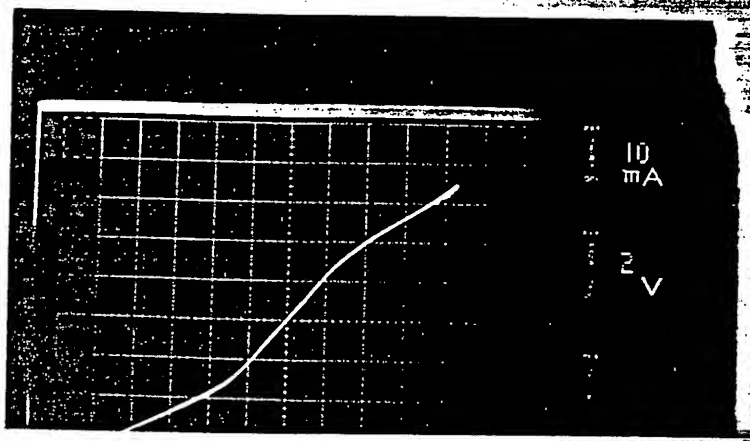
H = 3.2" high end.

Continued on Page

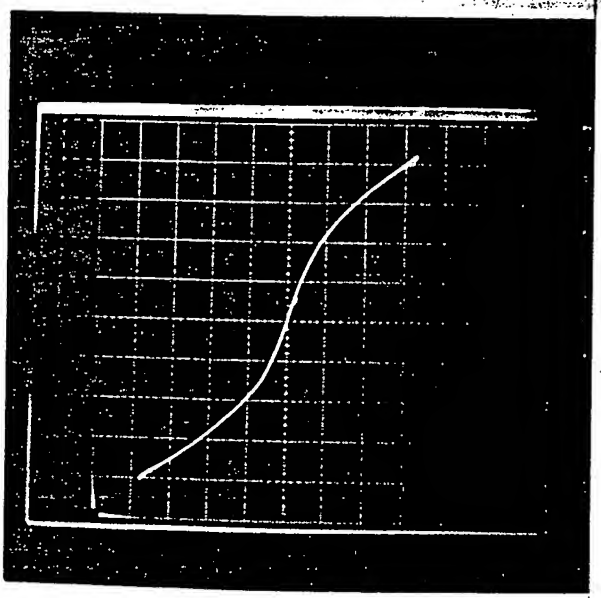


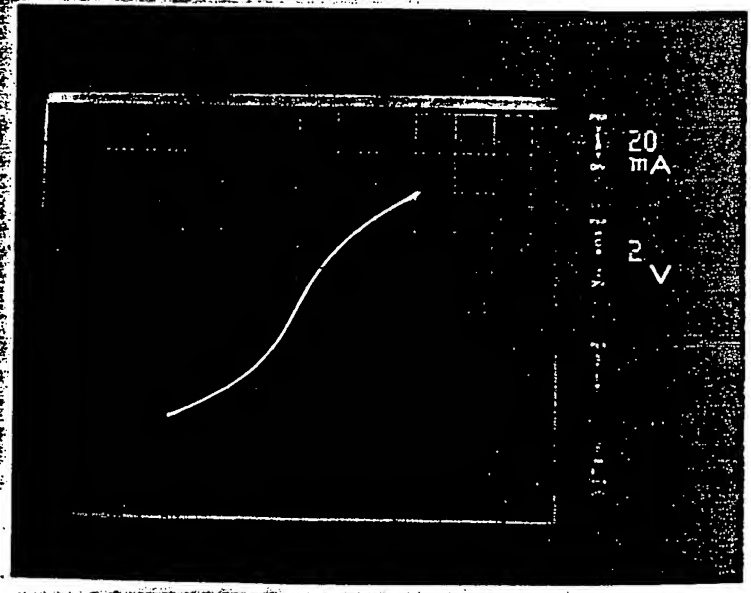
← No Etching.

PAGE 17



← 40" Etching





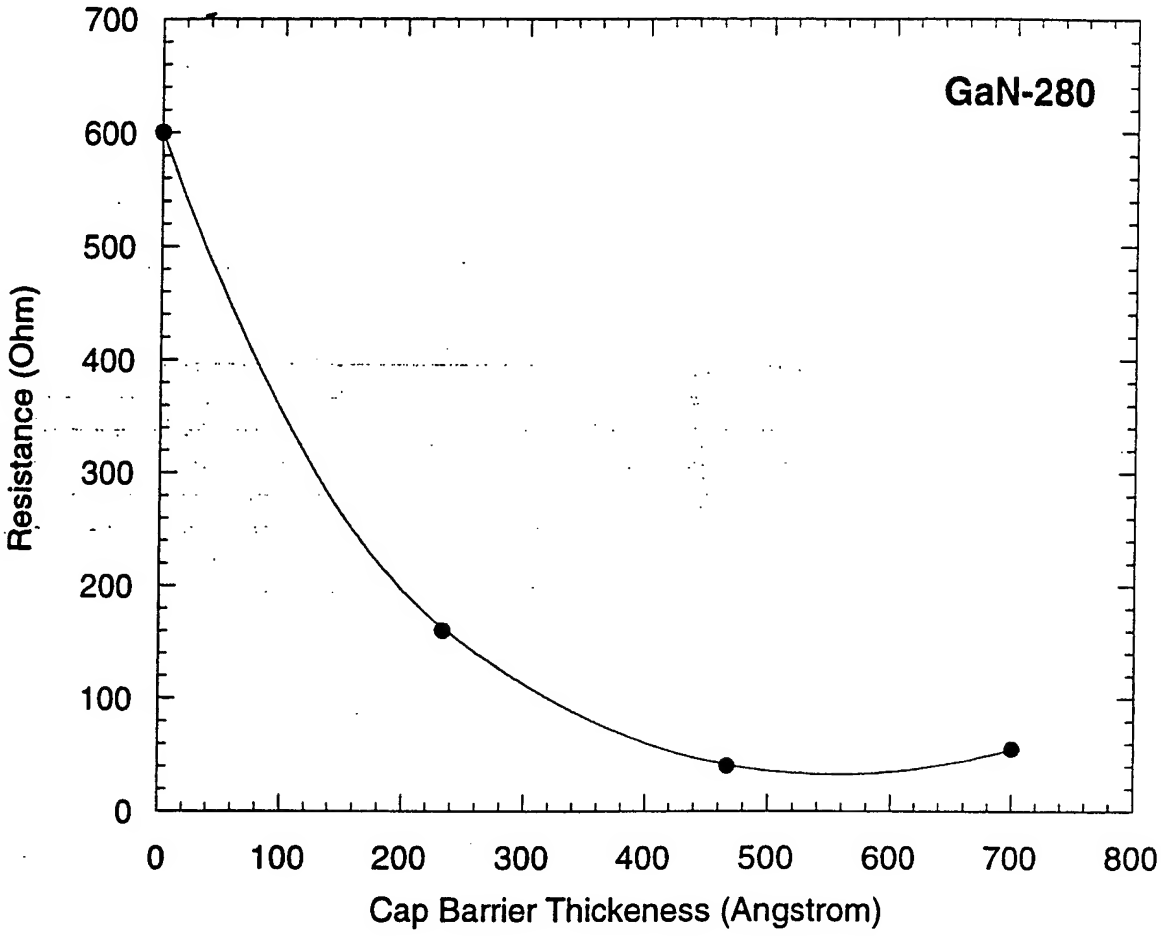
1'20" Etching

2'0" Etching

Continued on Page

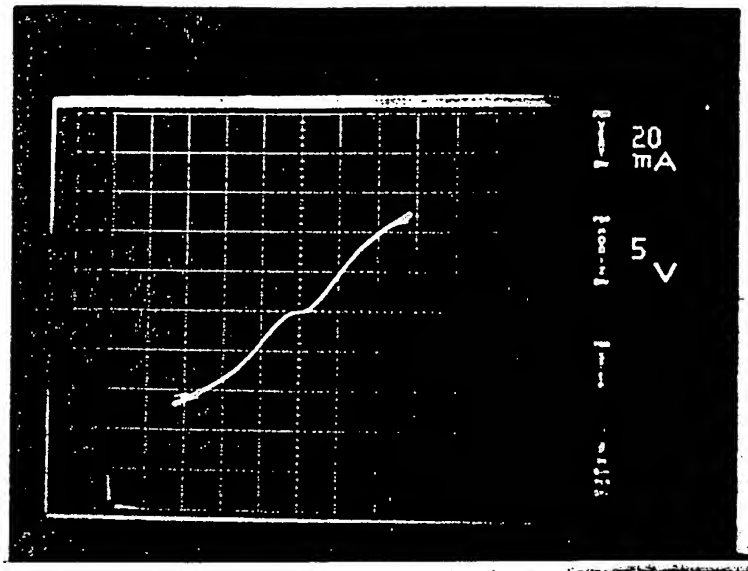
Read and Understood By

Signed Date Signed Date

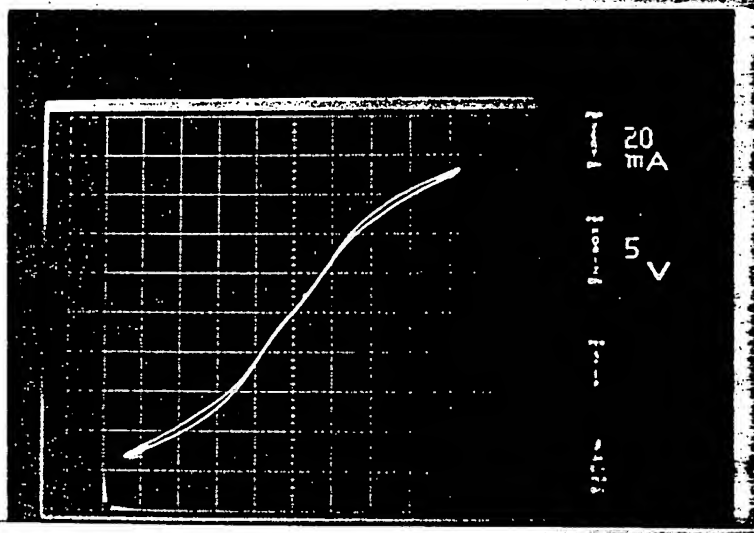


Continued on Page

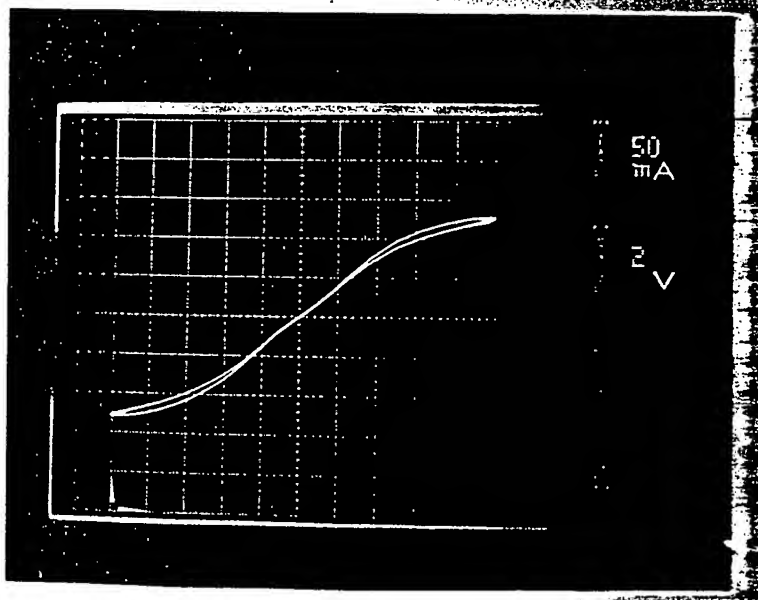
Read and Understood By



← 40" Etching



← 1'20" Etching



← 2'0" Etching

PAGE 18

Continued on Page

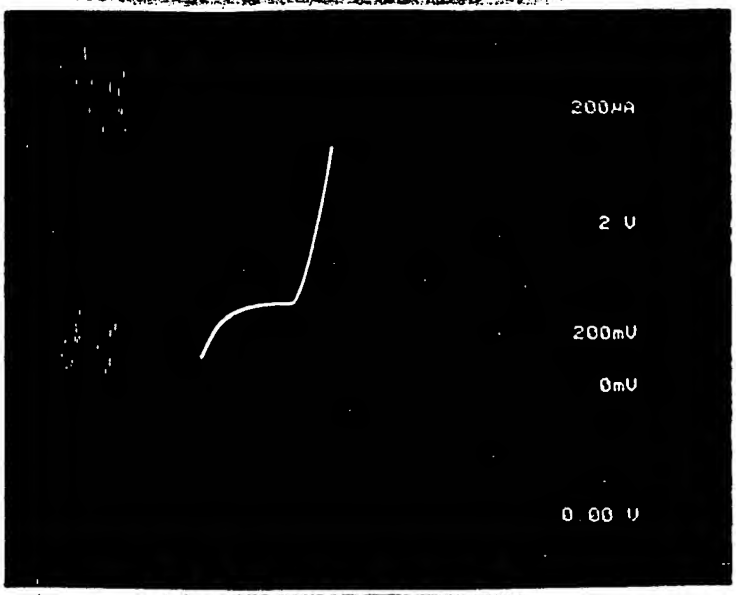
Understood By

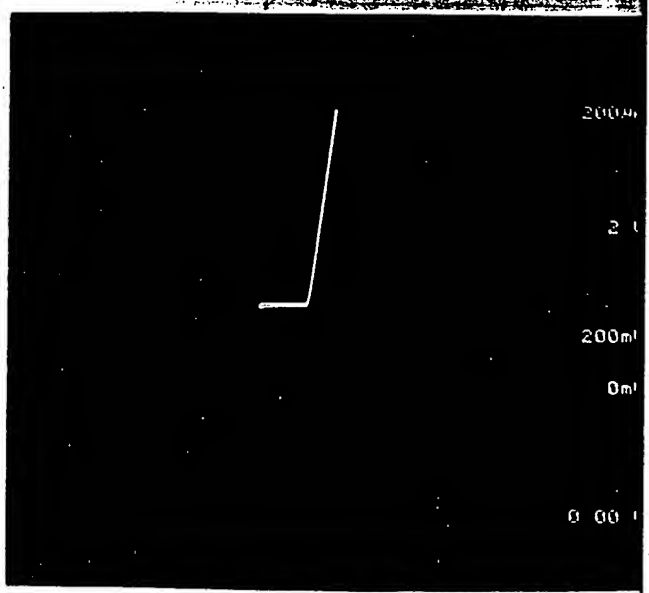
Signed Date Signed Date

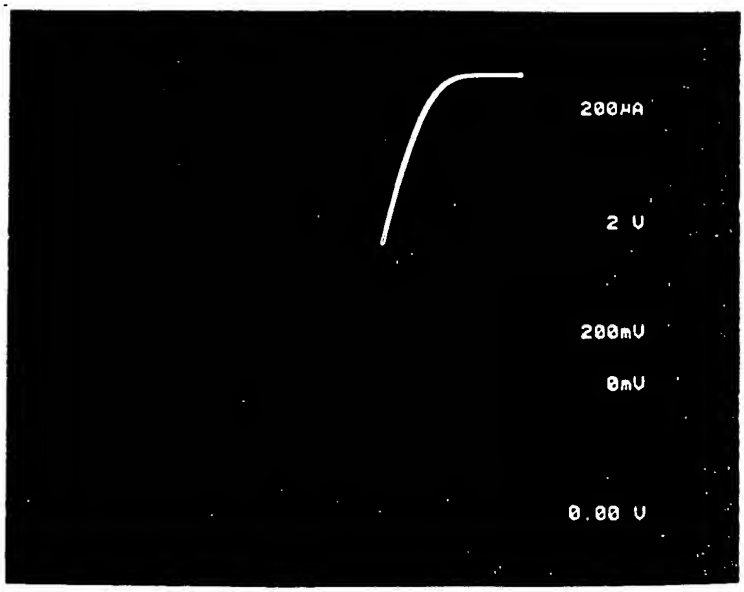
PROJECT

Notebook No. _____

Continued From Page _____

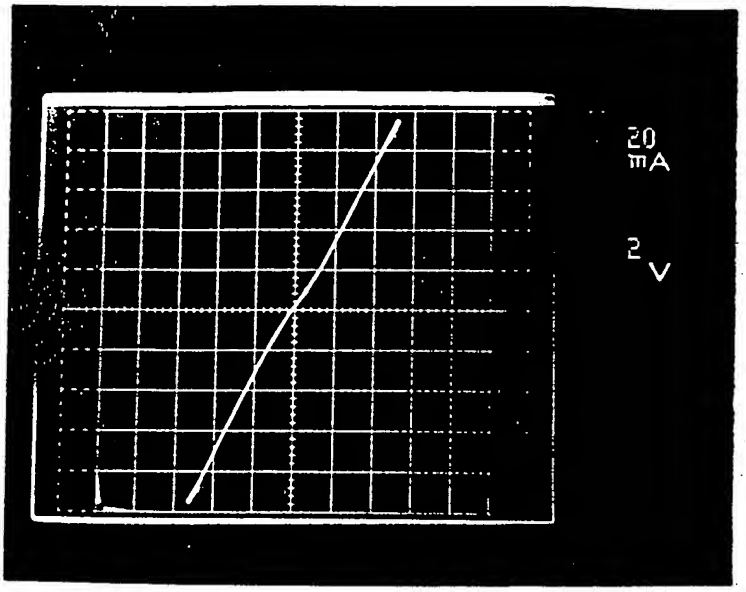


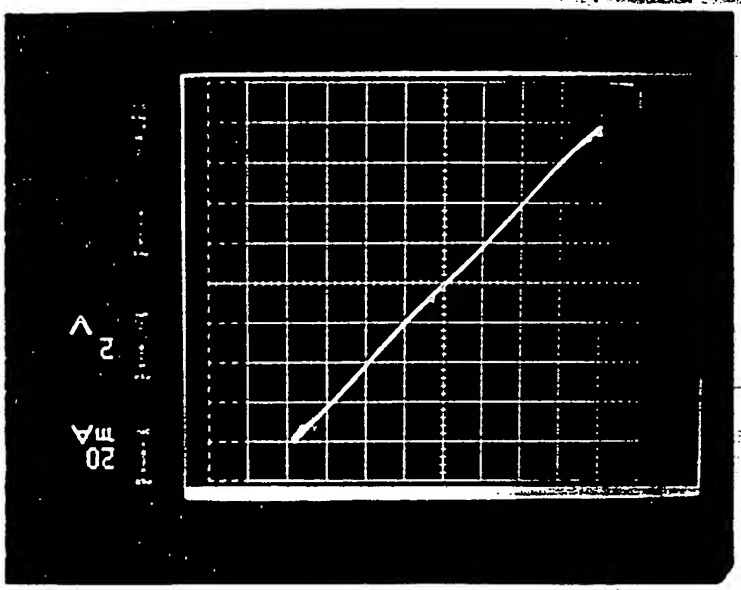




Continued on Page

Read and Understood By

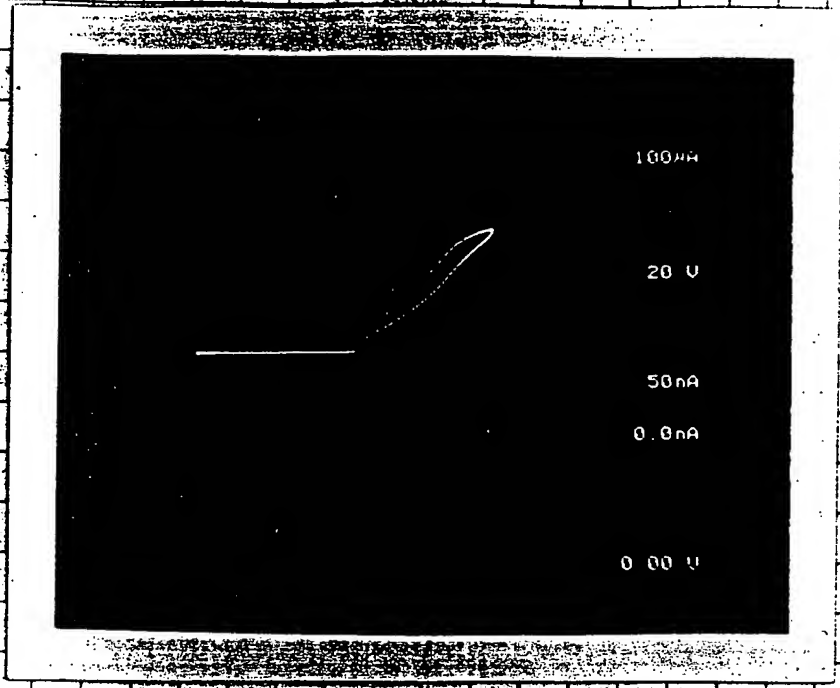




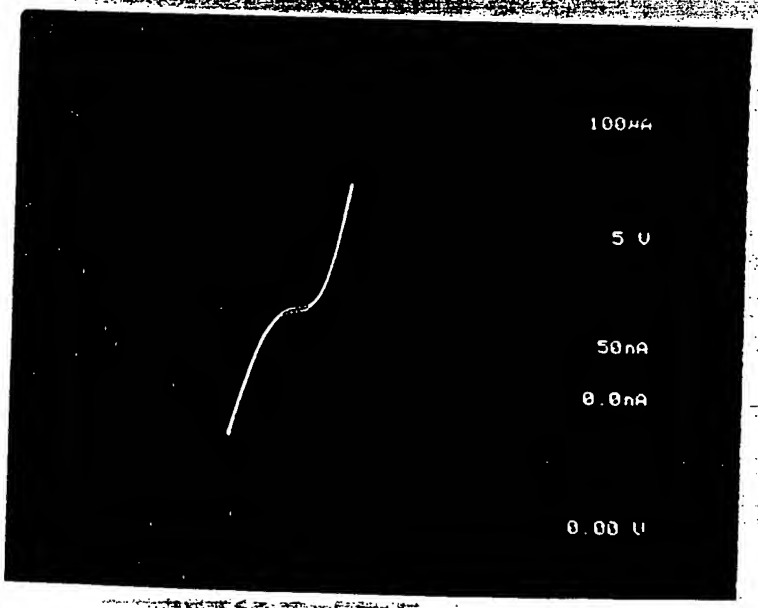
Continued on Page

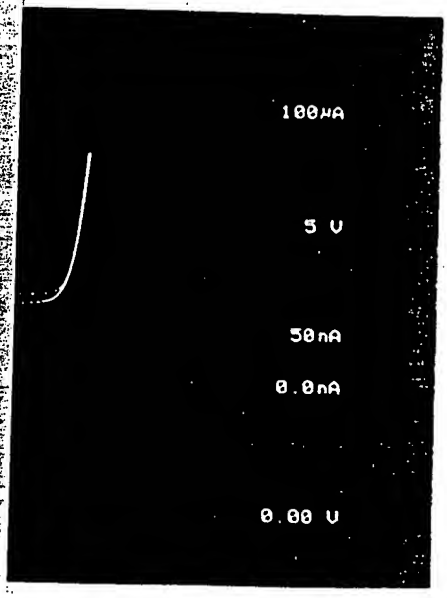
Read and Understood By

Signed	Date	Signed	Date



981021 FE





981022FB

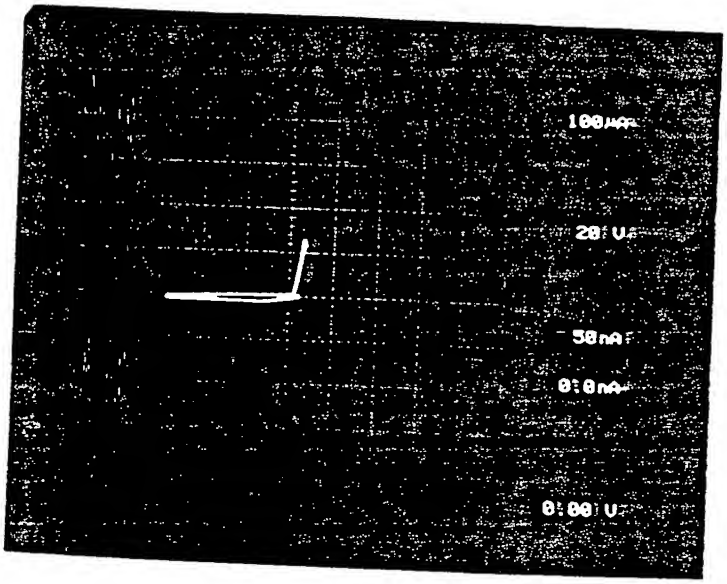
981022FB

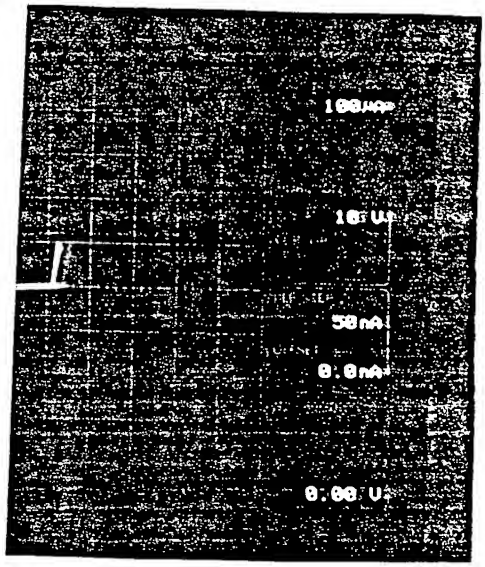
Continued on Page

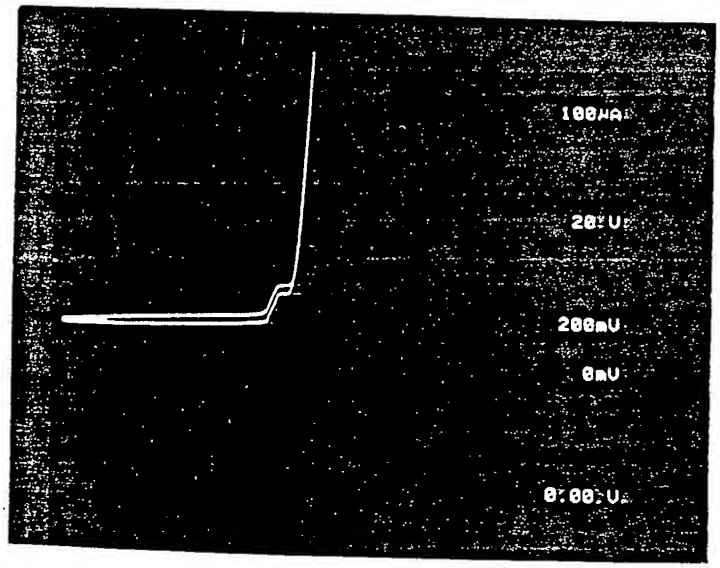
Read and Understood By

Signed _____ Date _____ Signed _____ Date _____

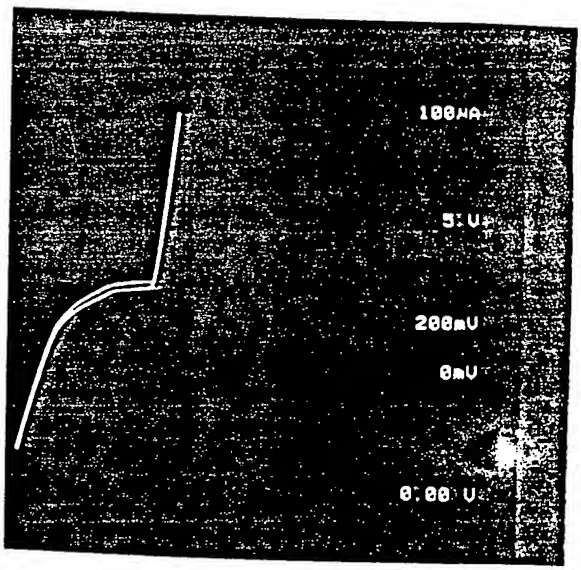
← 98(2)FD →







GN-299



GN-255

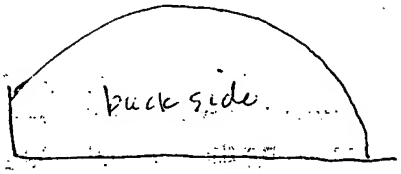
Signed

GaN 415

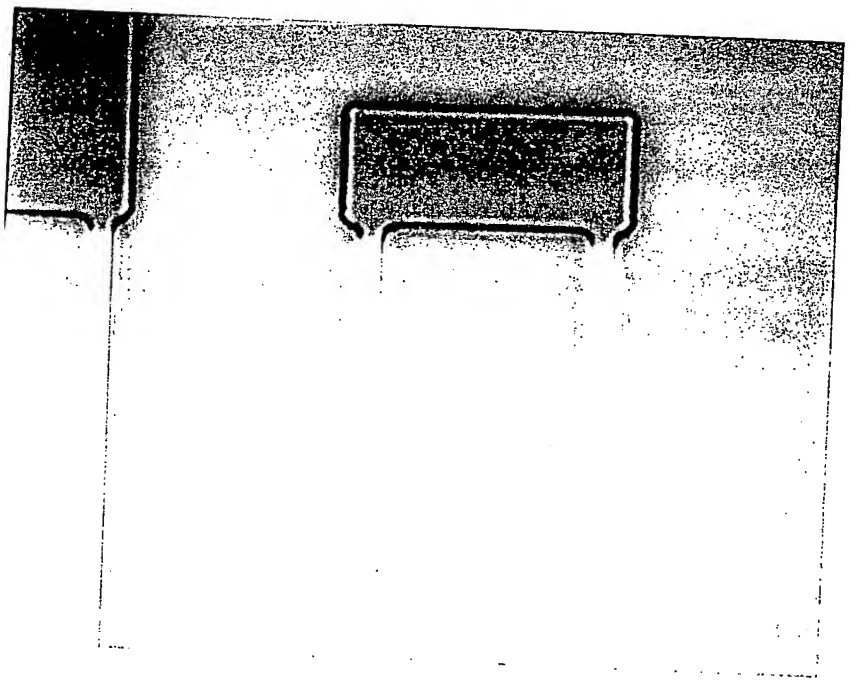
GaN 420
sapphire

415  flat

415 No flat 

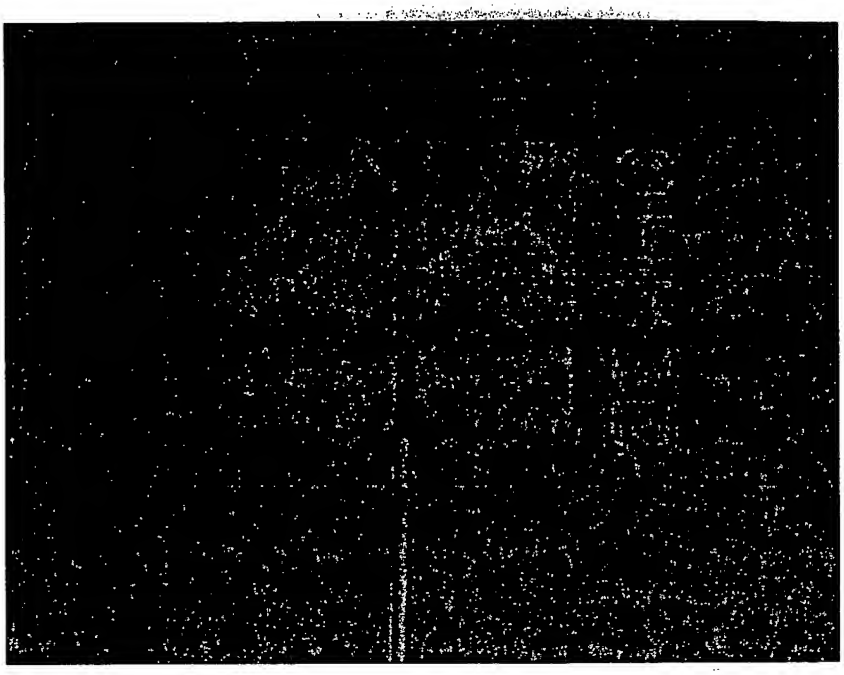
WT 990409A1 

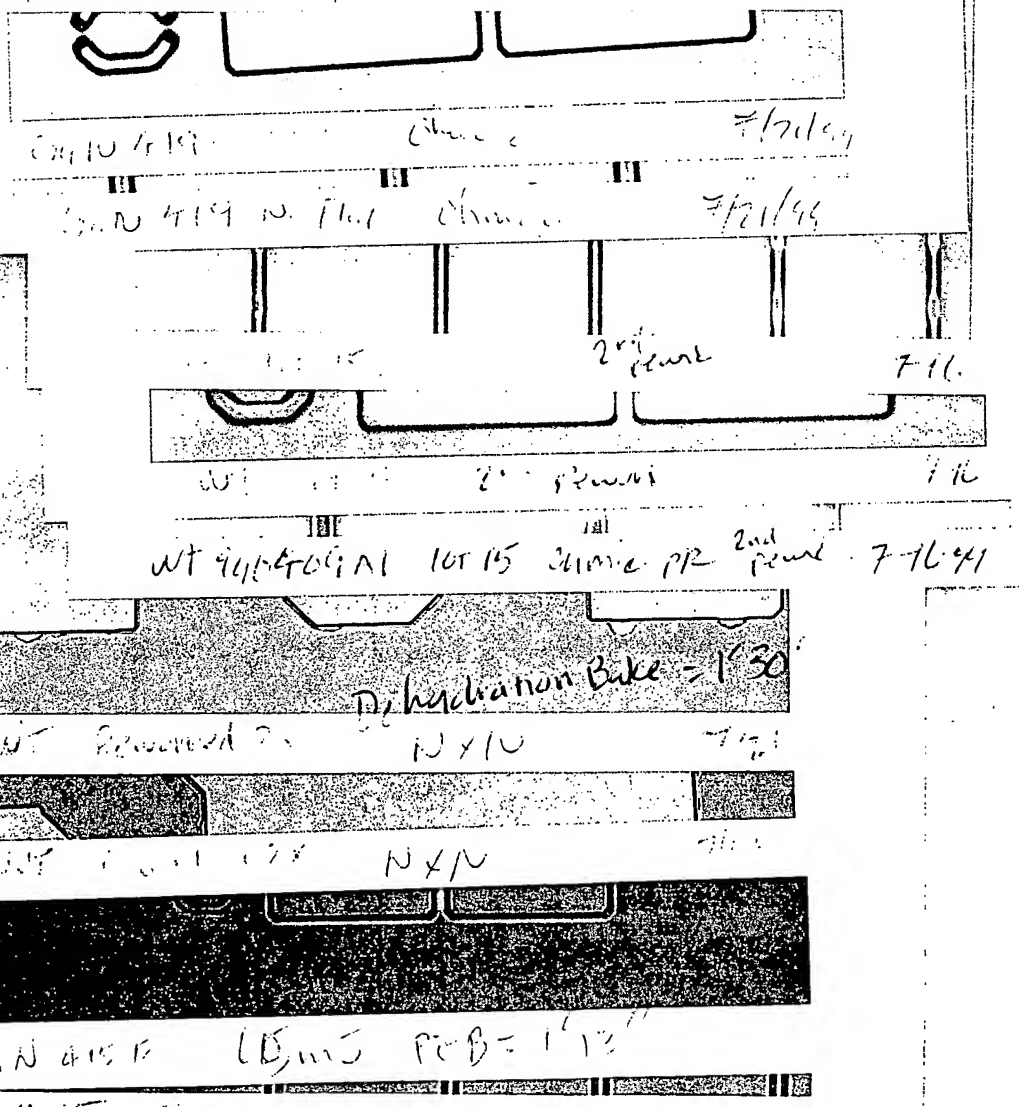
GaN 419 = No Flat 
sapphire

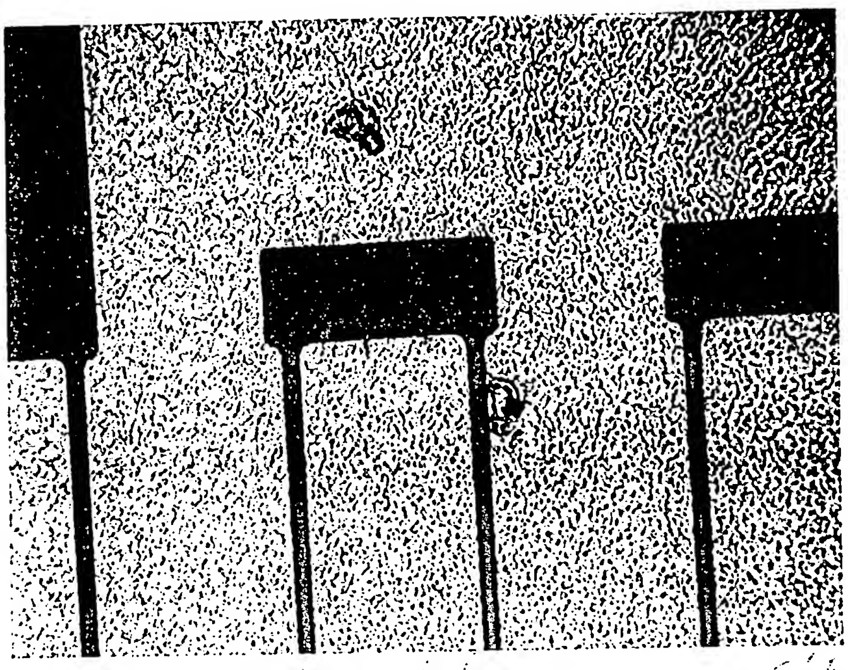


GaN 415 lot 15 chunk 7-13-99
15 flat

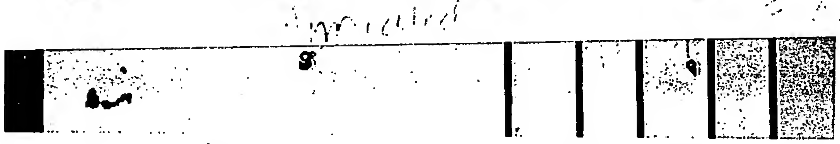
lot 15



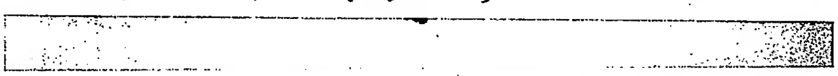




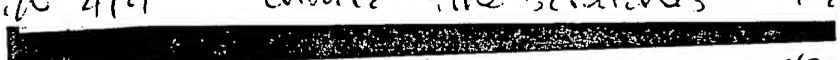
[illegible]



GaN 414 ohmic scratch 7-26

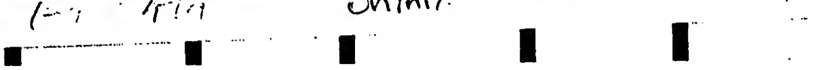


GaN 414 ohmic fine scratches 7-26



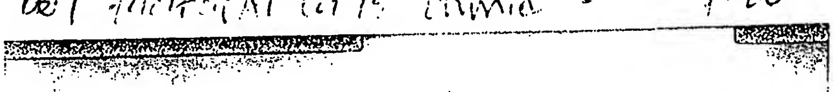
7/26

[illegible] 414 ohmic

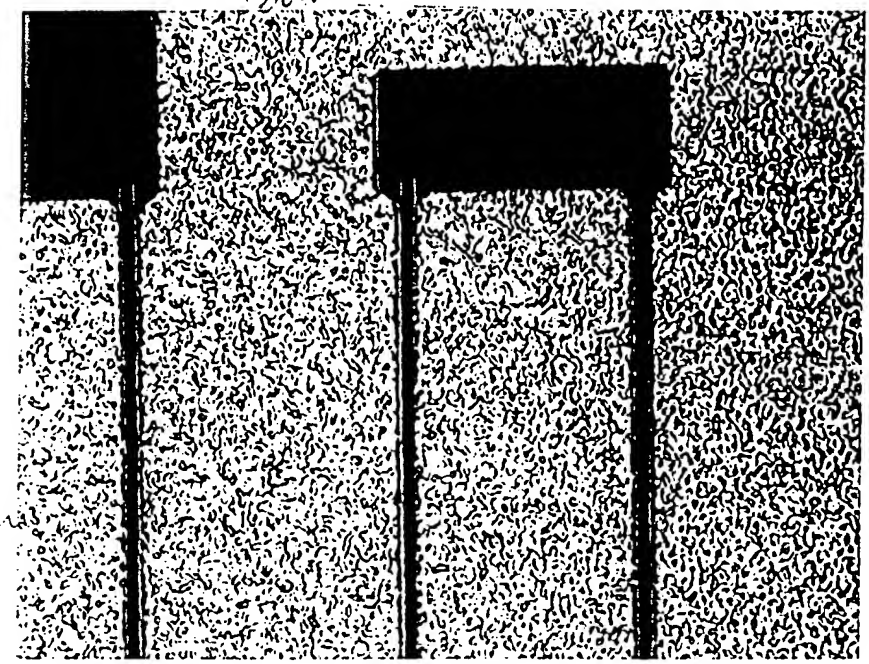


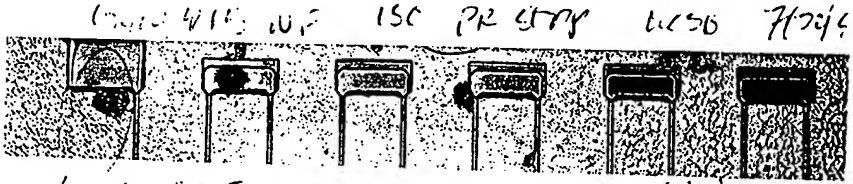
GaN 414 ohmic [illegible] 7-26-96

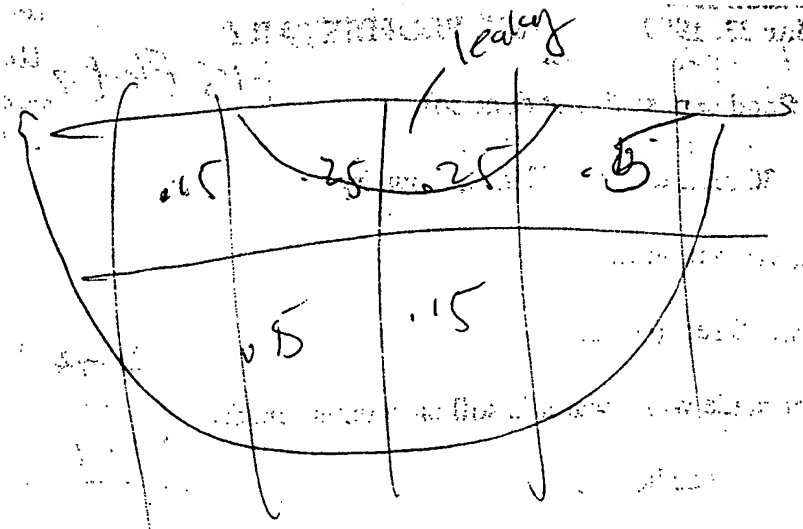
UT [illegible] lot 15 ohmic [illegible] 7-26

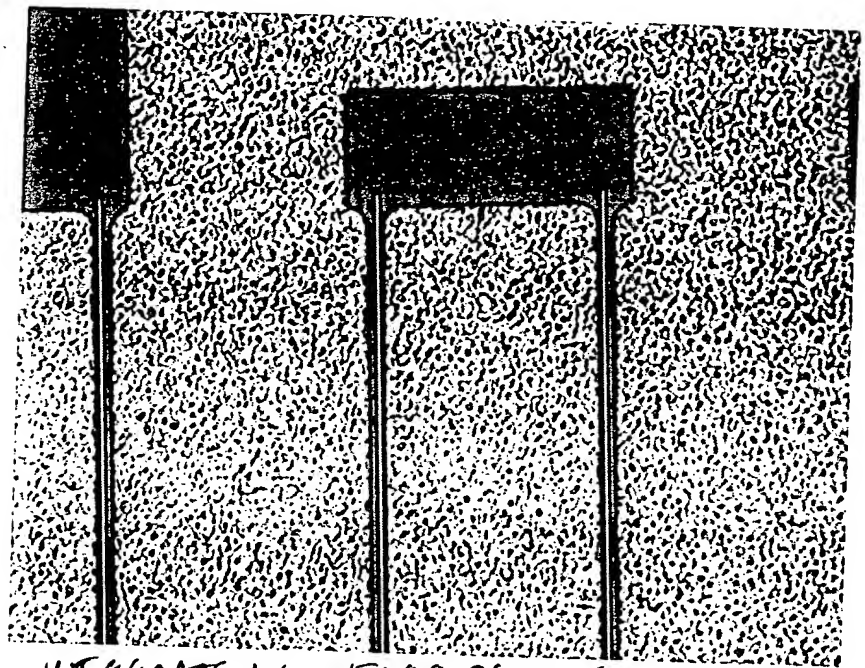


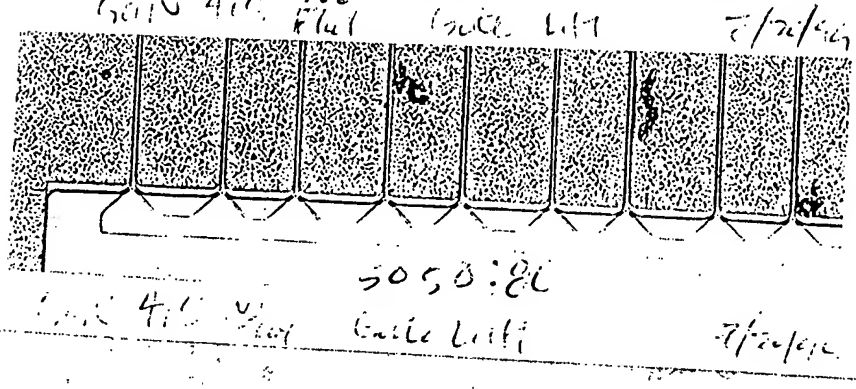
B[illegible] N 415 F [illegible] 7-26-96






leaky
.15
.25
.25
.15
.15


WT990409A1 15048 86 0.15mm 8-10-99
5051:86 WT990409A1 0.5mm 8-10-99
WT 990409 5040 86 0.25mm 9-10-99
86



Exposure Request

Wafer Without Traveller

Date: 8-4-99 By: Paul Sac 1 Davis c443

This section to be completed by submitter

Wafer #	GaN 419 GaN 420
Charge #:	BDGN3AL
Mask Set	Power 1
Pattern to be Exposed (ie gate layer, ohmic, etc)	gate
Required Resist Coating:	
CD Target	0.25 μm
Tolerance	

PRIORITY # 2 à 3

This section to be completed when coated

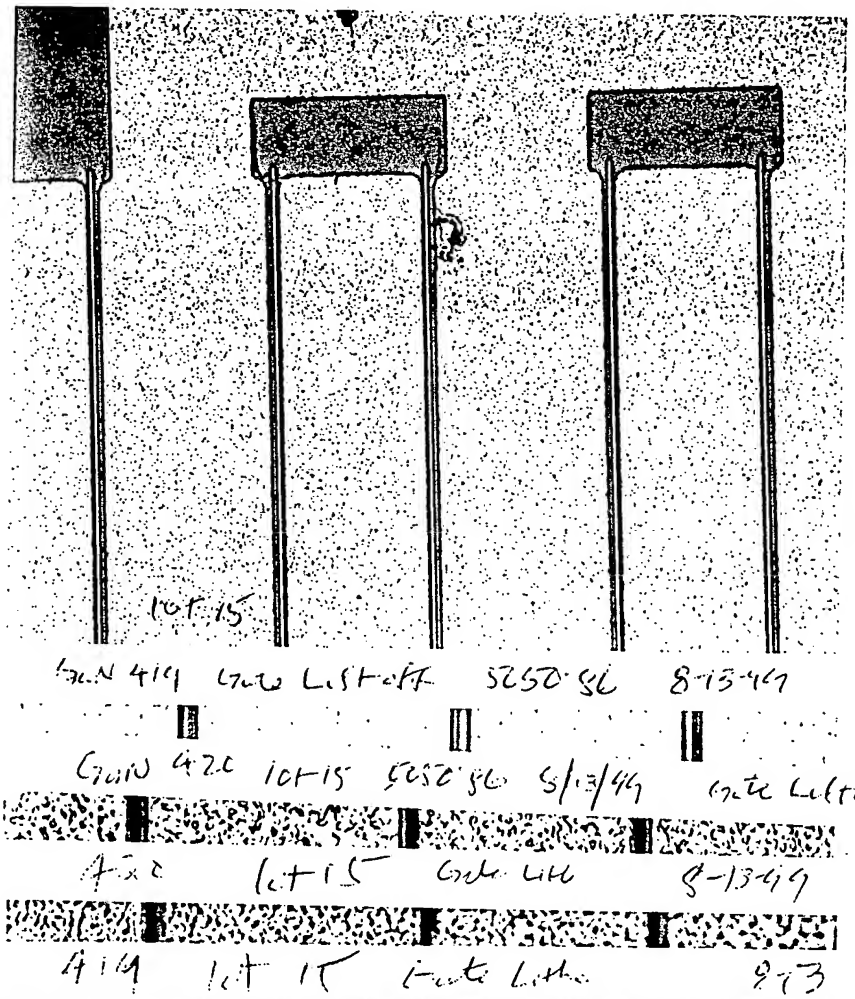
Resist Coating Date: _____ By: _____

PMMA	Copolymer	PMMA

This section to be completed when exposed

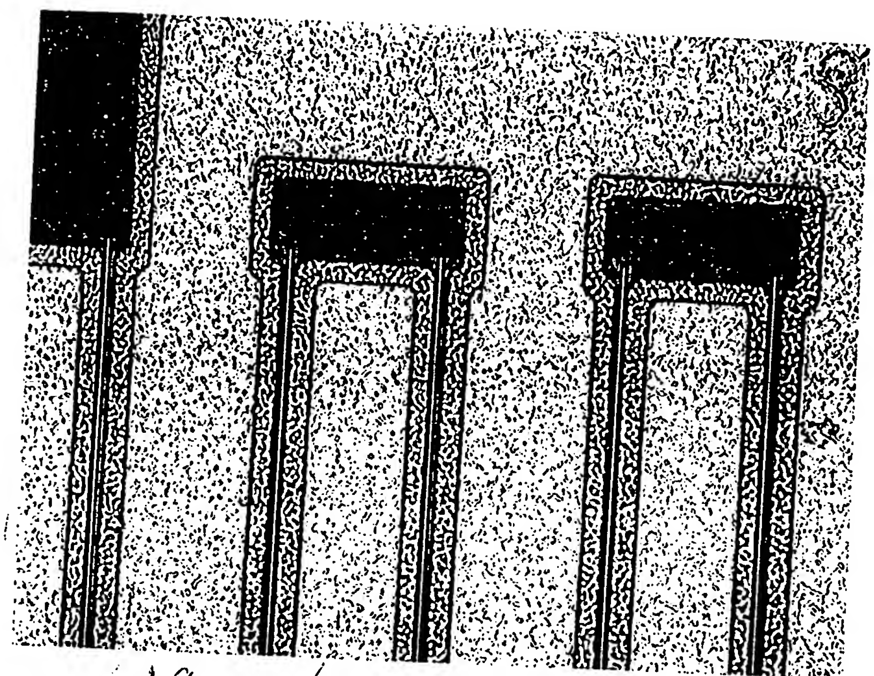
Exposure Parameters Date: _____ By: _____

Pattern name

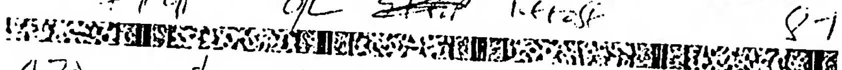


IPA

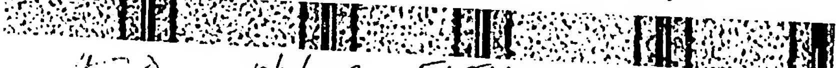
IPA



419 O/L Litho 8-17-99



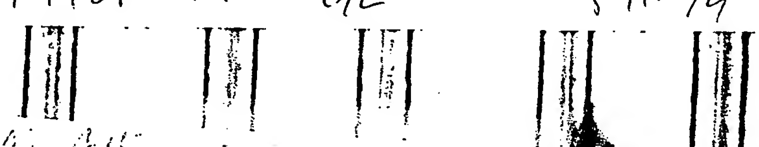
420 O/L Litho 8-17-99



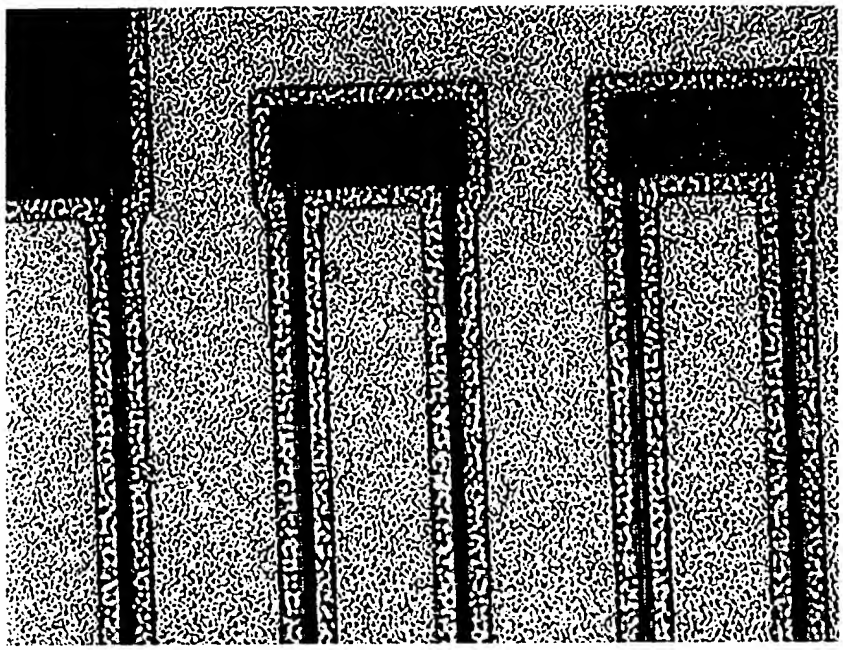
420 O/L/PR 5050:84 8-16-99

G4N 419 OL PR 8-16-99

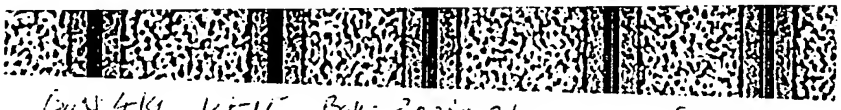
WT990406A1 O/L 8-11-99



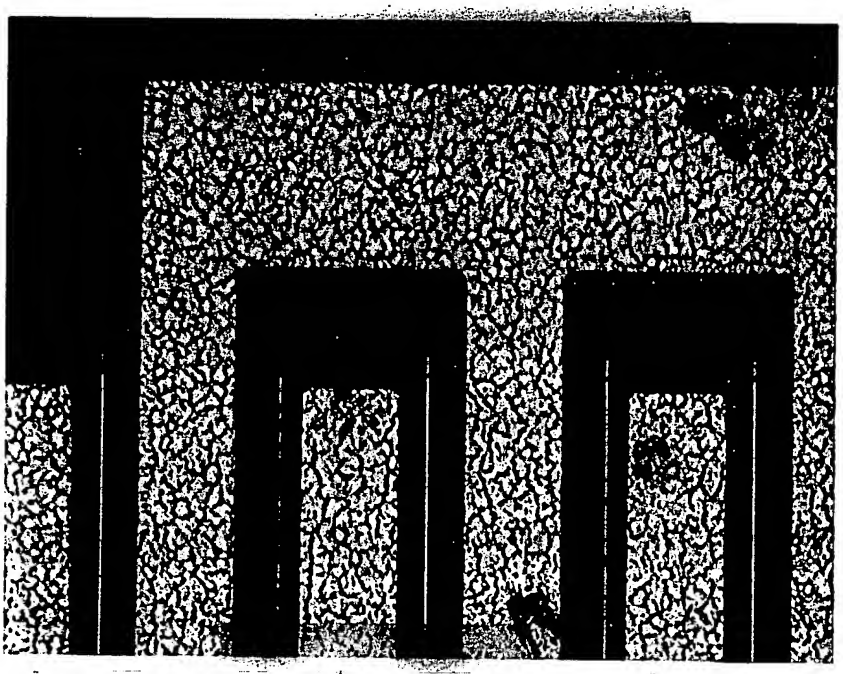
7-21-99



GaN 42C 1ct-15 Bake 300°C 2hrs 5-17-94



GaN 41C 1ct-15 Bake 300°C 2hrs 5-17-94

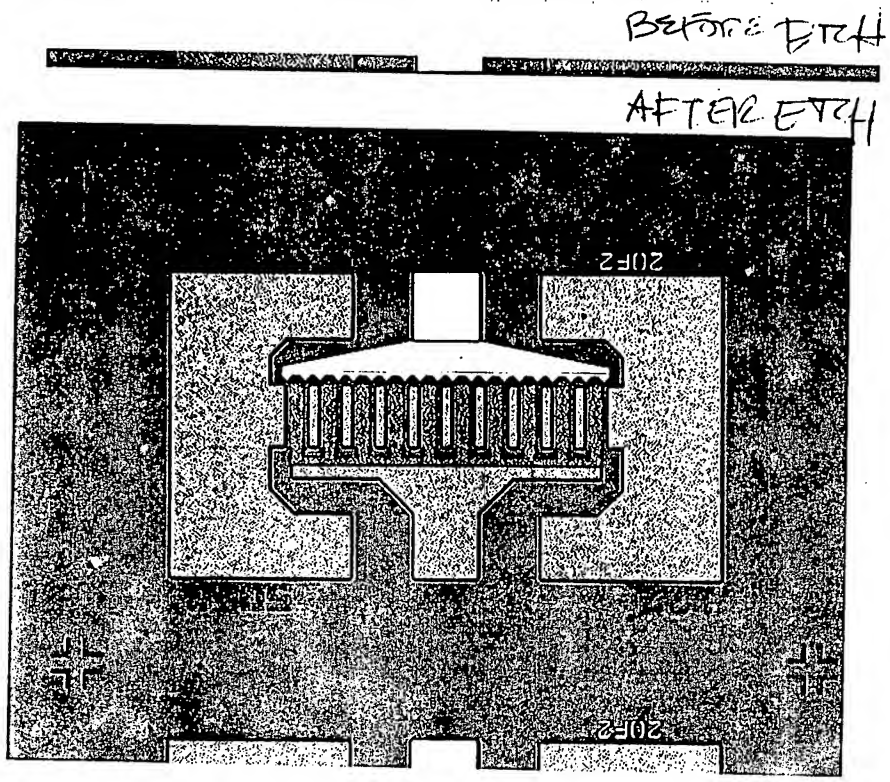


Rosanne

8/17/99

11:15

1½:15



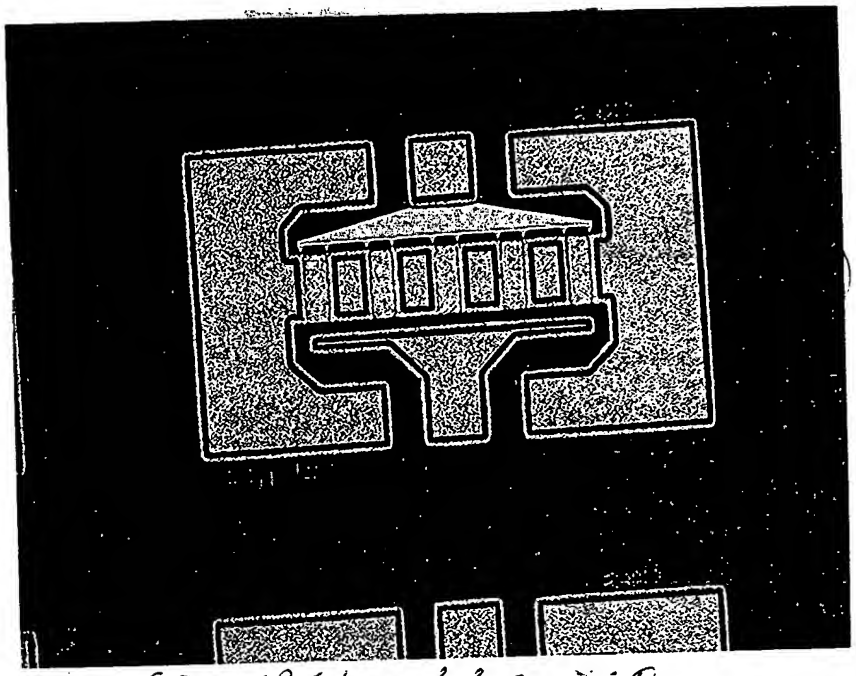
C/# BD9N364L Sample: WT990409A1

Rosanne: Please use ICP to etch 2-3 μm polyimide (PI) from inside pattern areas (X) marked where end point

Left

FOR Roxanna
STEVE T

8/26/99



Front side down

WT9904094A1 before ICP

C/# BDGN364L Sample WT9904094A1

Steve Roxanna: Please use ICP to etch Polyimide (PI2) from the field area ⊗ marked where end point can be used.

Typical 10–11 seconds, with 2–3 min overetch, total time 10–11 min.

Thanks. Please call x5743 when done & put in "OUT BOX".

Danny

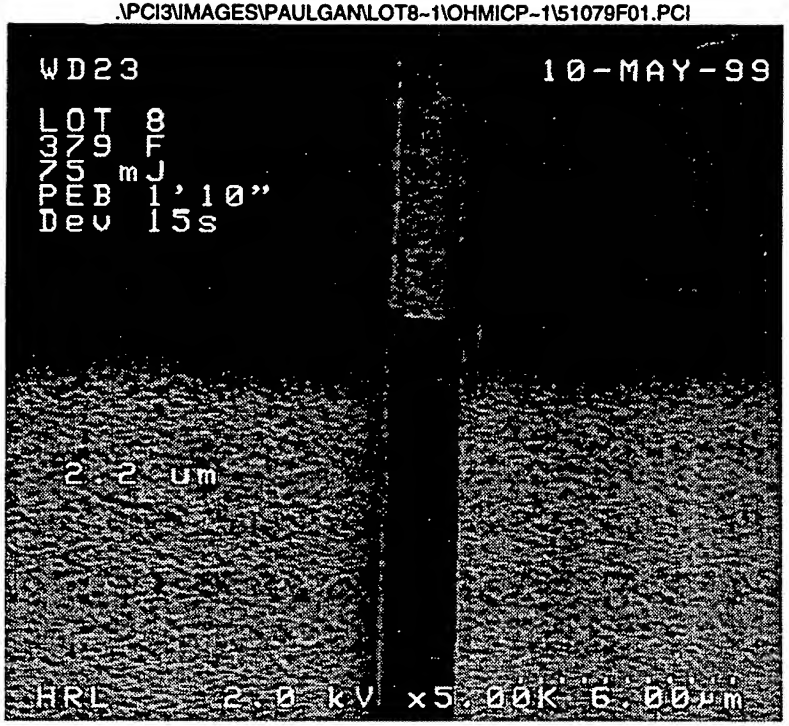
ICP has been shut down

ICP: Run # 2129
10 per. 11'23"

8/25/99

179749

.\PCI3\IMAGES\PAULGAN\LOT8~1\OHMICP~1\51079F01.PCI

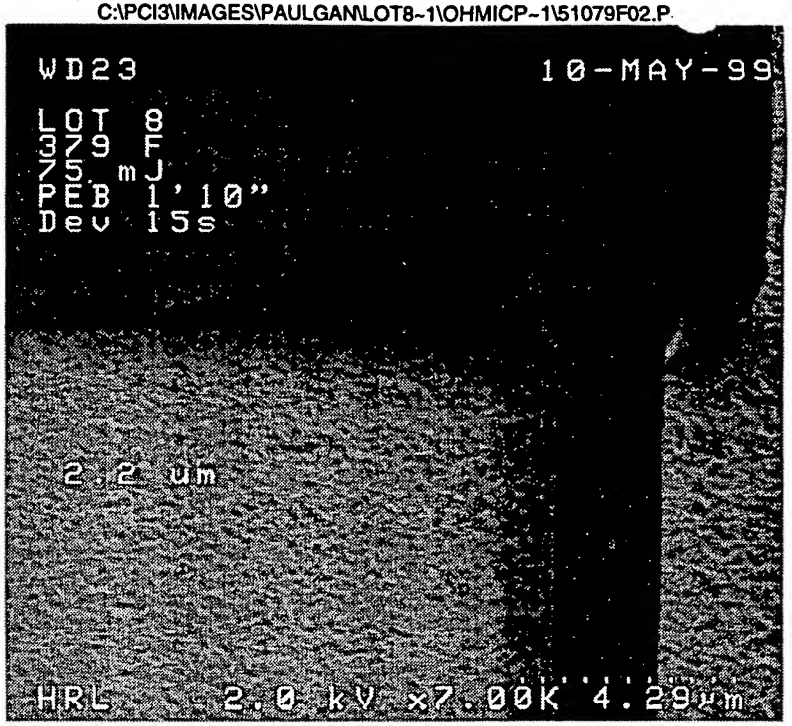


75 mj w/ hard contact

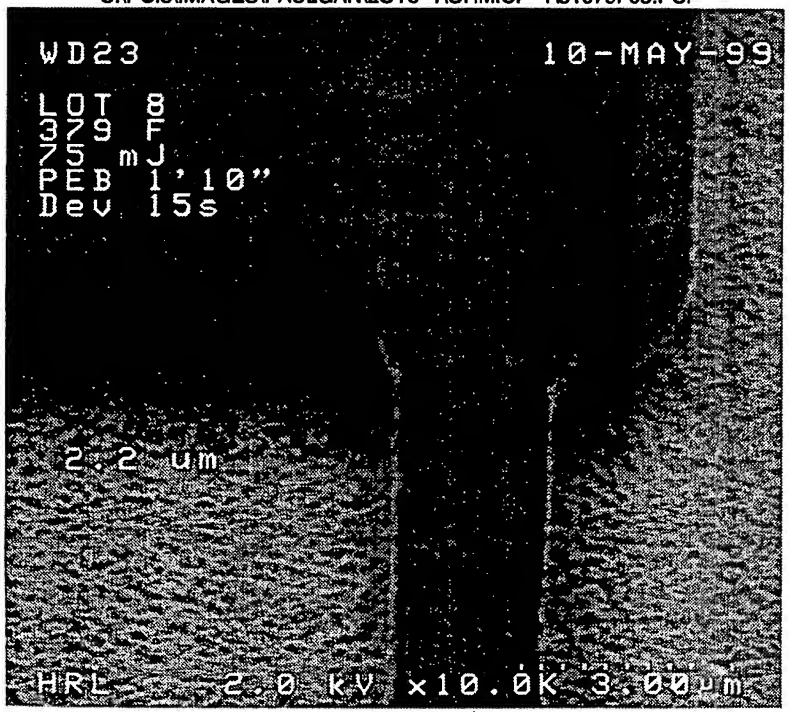
profile too re-entrant

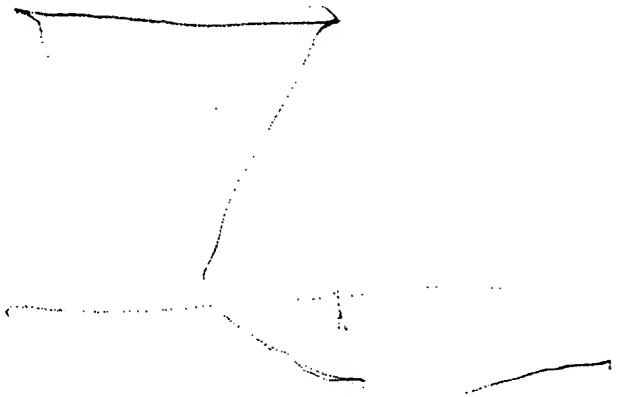
contact not uniform

C:\PCI3\IMAGES\PAULGAN\LOT8~1\OHMICP~1\51079F02.P

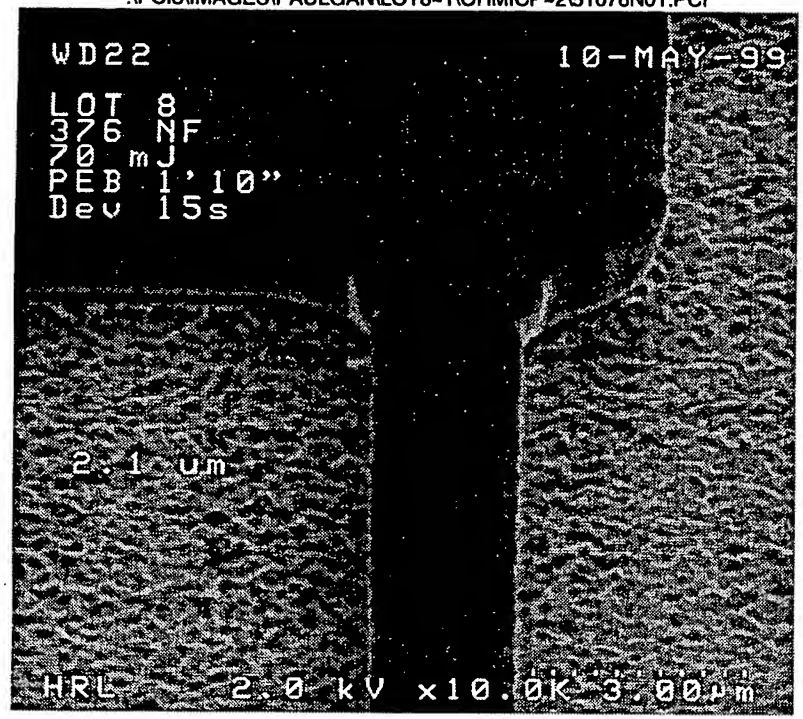


C:\PCI3\IMAGES\PAULGAN\LOT8~1\OHMICP~1\51079F03.PCI





.\PCI3\IMAGES\PAULGAN\LOT8~1\OHMICP~2\51076N01.PCI

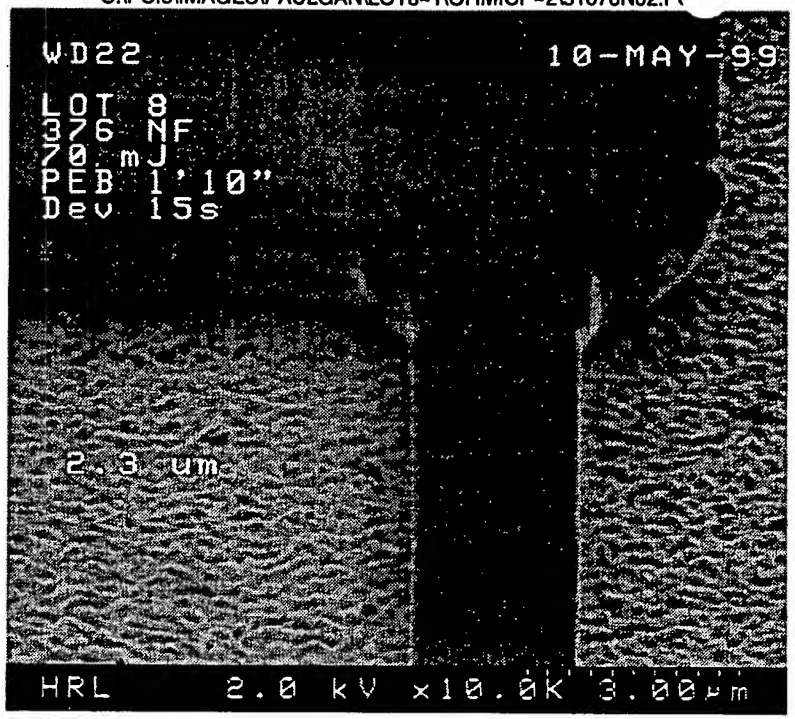


70 mJ
contact
= softer

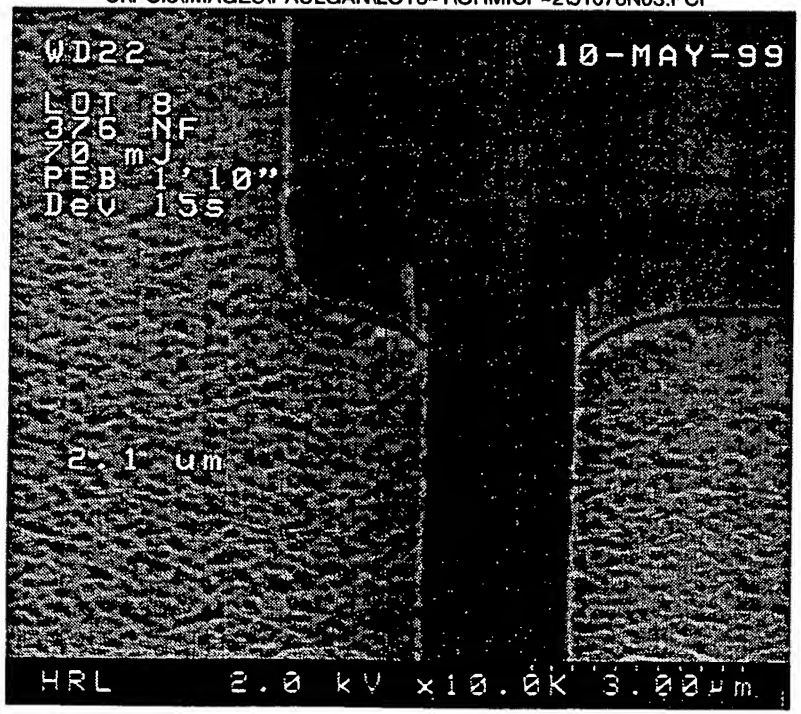
- still
profile
non-
reentrat

contact
not
uniform

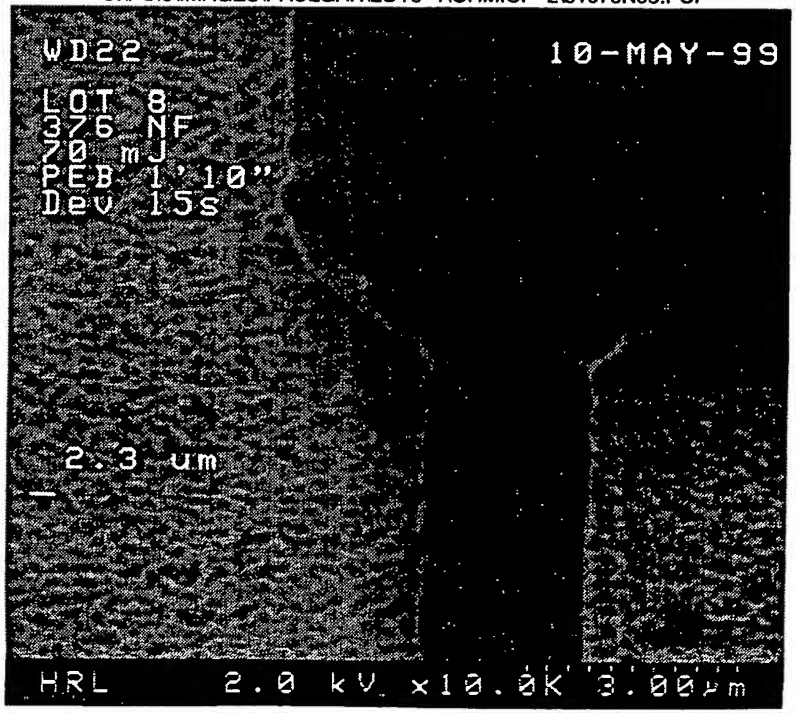
C:\PCI3\IMAGES\PAULGAN\LOT8~1\OHMICP~2\51076N02.P(



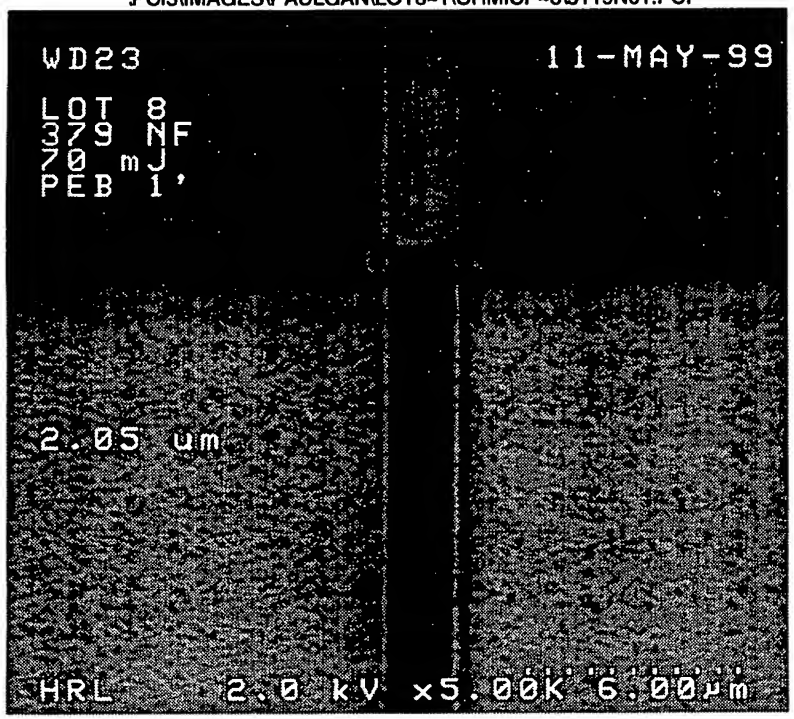
C:\PCI3\IMAGES\PAULGAN\LOT8~1\OHMICP~2\51076N03.PCI



C:\PCI3\IMAGES\PAULGAN\LOT8~1\OHMICP~2\51076N05.PCI



.PCI3\IMAGES\PAULGAN\LOT8~1\OHMICP~3\5119N01.PCI



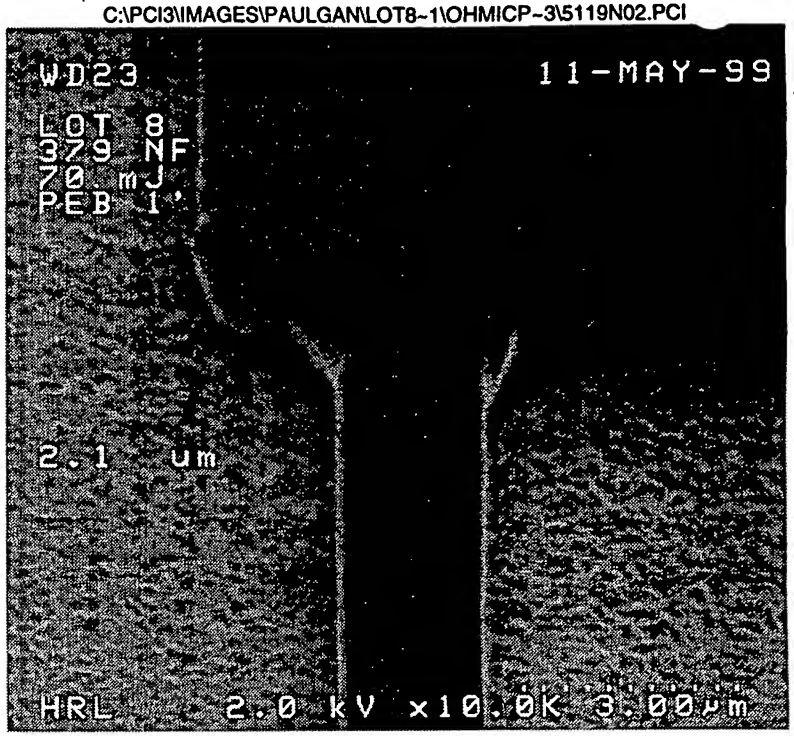
5-11-19

379 NF

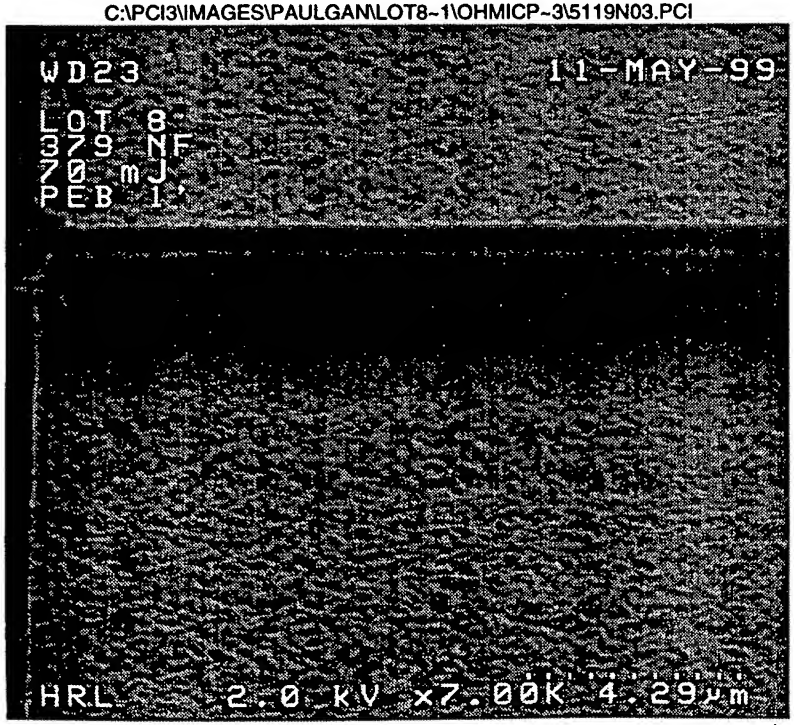
70 mJ

PEB = 1'

C:\PCI3\IMAGES\PAULGAN\LOT8~1\OHMICP~3\5119N02.PCI

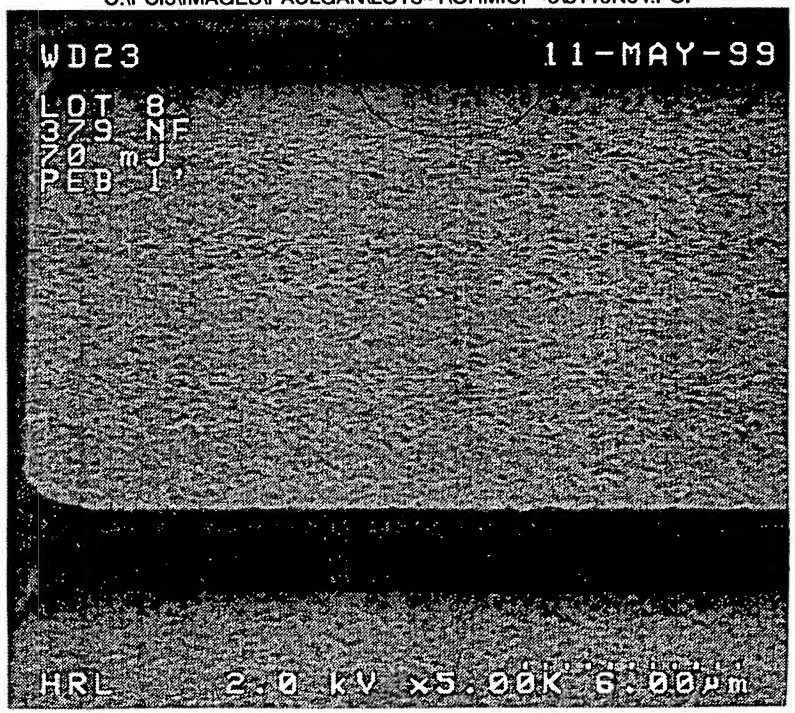


C:\PCI3\IMAGES\PAULGAN\LOT8~1\OHMICP~3\5119N03.PCI

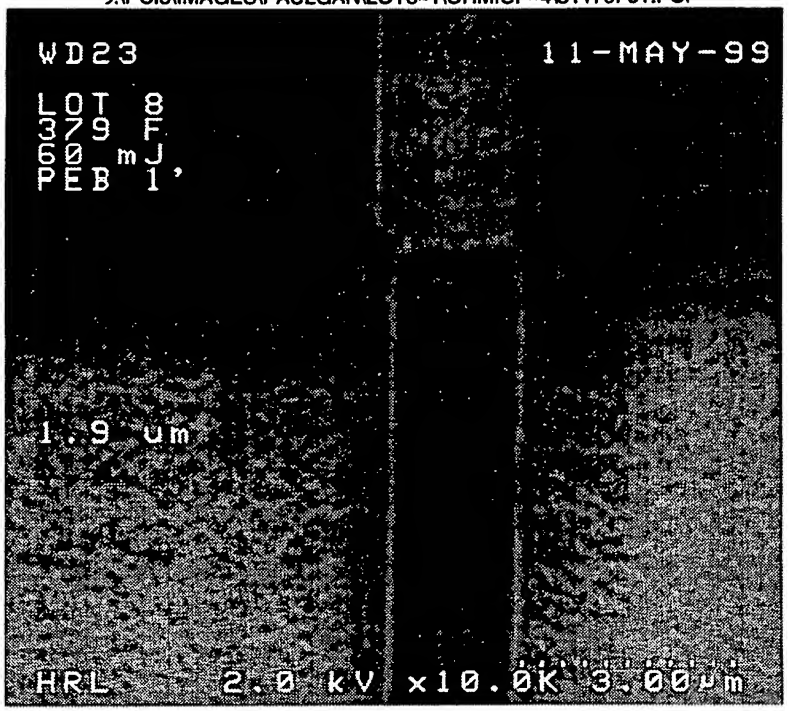


trace scalloping one area small

C:\PCI3\IMAGES\PAULGAN\LOT8~1\OHMICP~3\5119N04.PCI

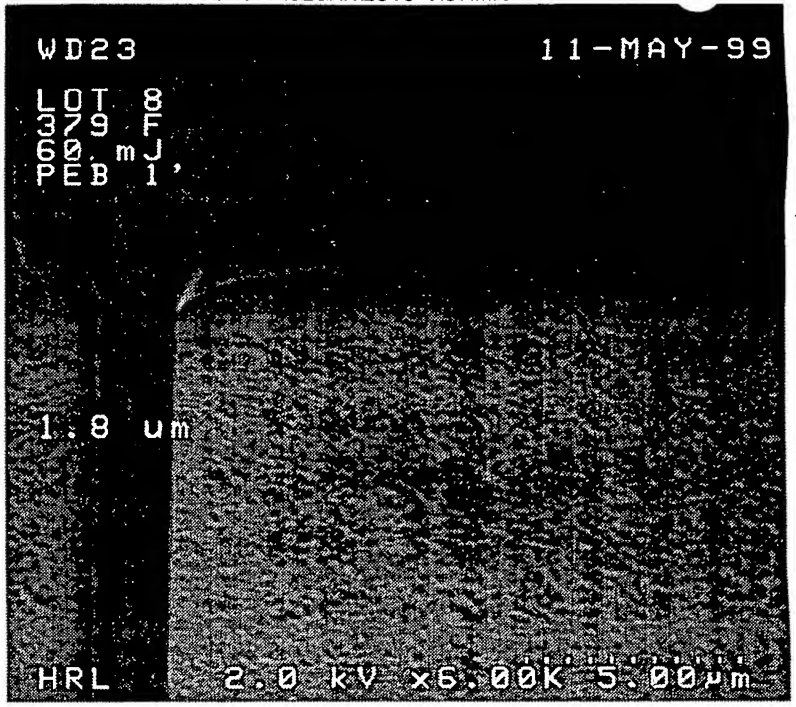


C:\PCI3\IMAGES\PAULGAN\LOT8~1\OHMICP~4\51179F01.PCI

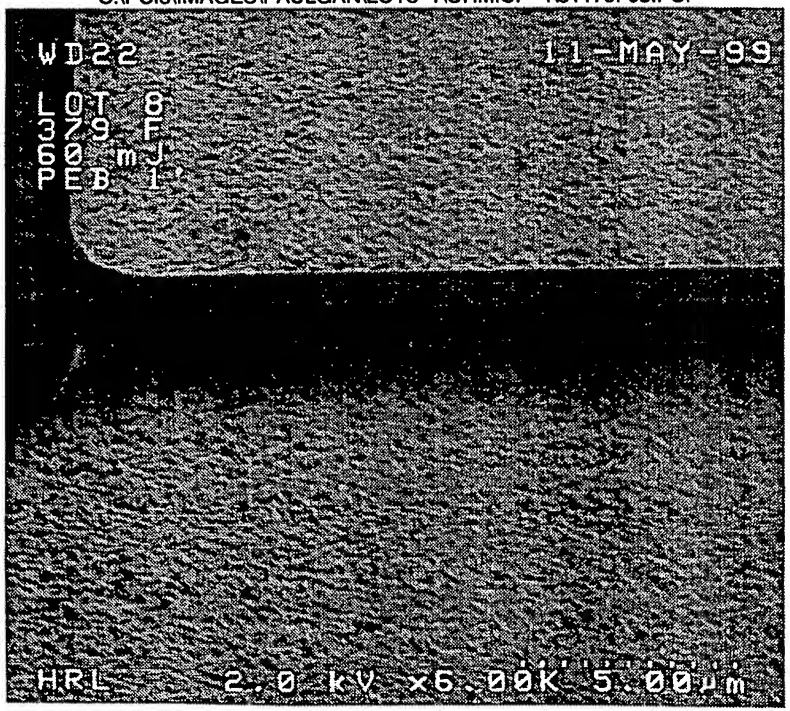


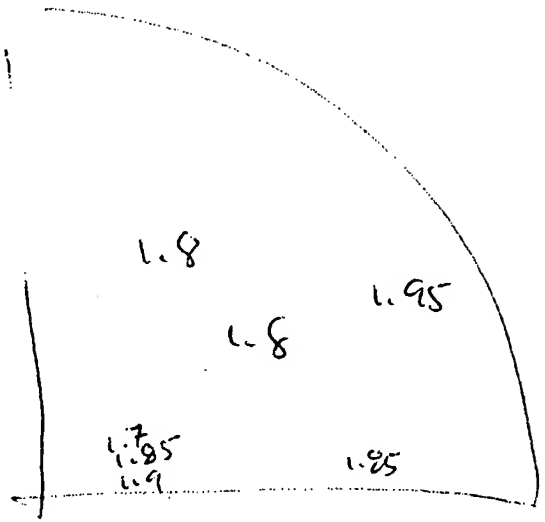
379 F
60 mJ
PEB = 1'

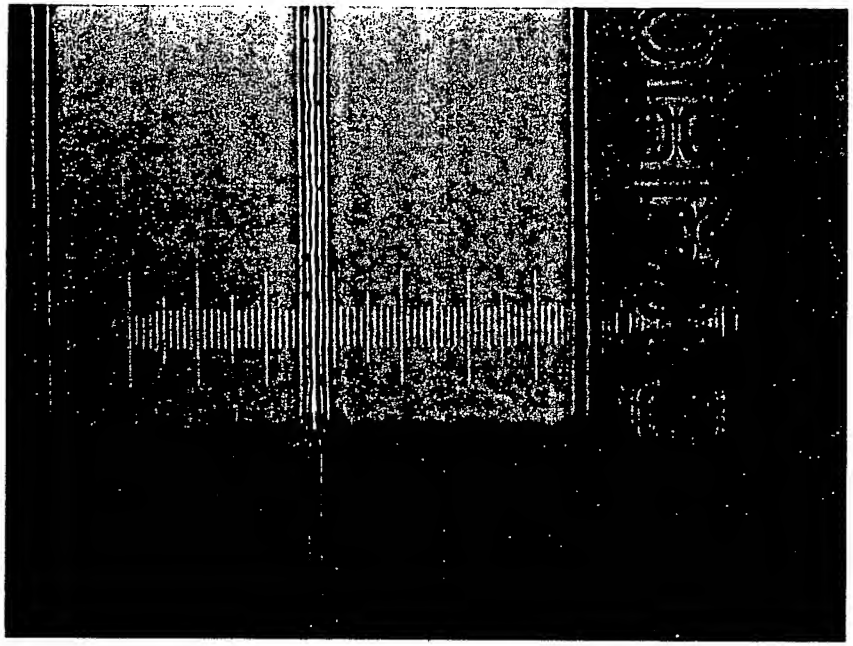
C:\PCI3\IMAGES\PAULGAN\LOT8~1\OHMICP~4\51179F02.P\



C:\PCI3\IMAGES\PAULGAN\LOT8~1\OHMICP~4\51179F03.PCI

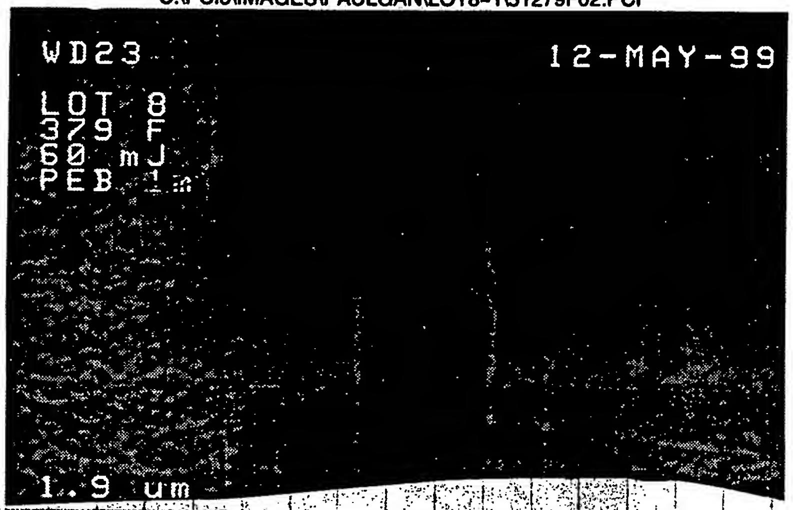




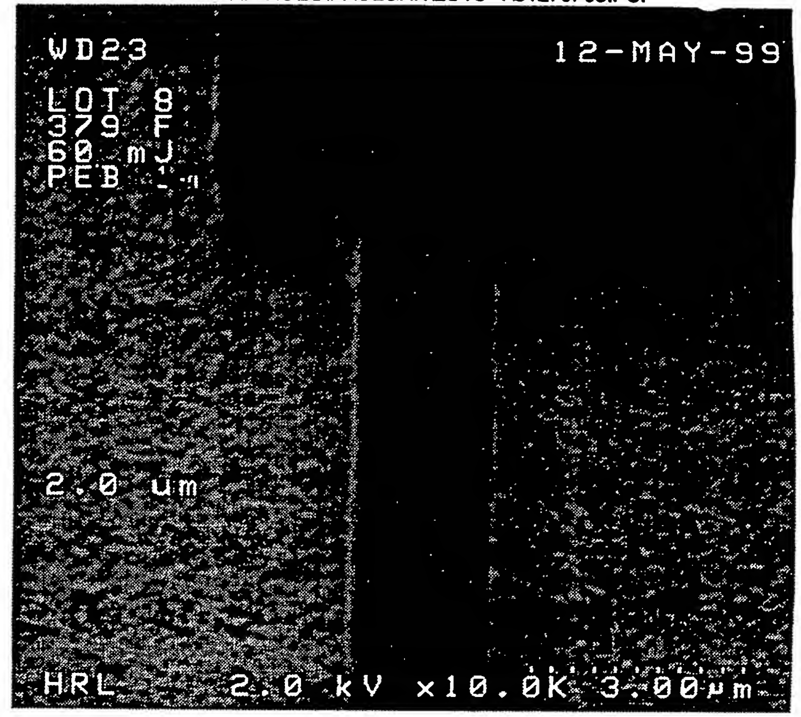


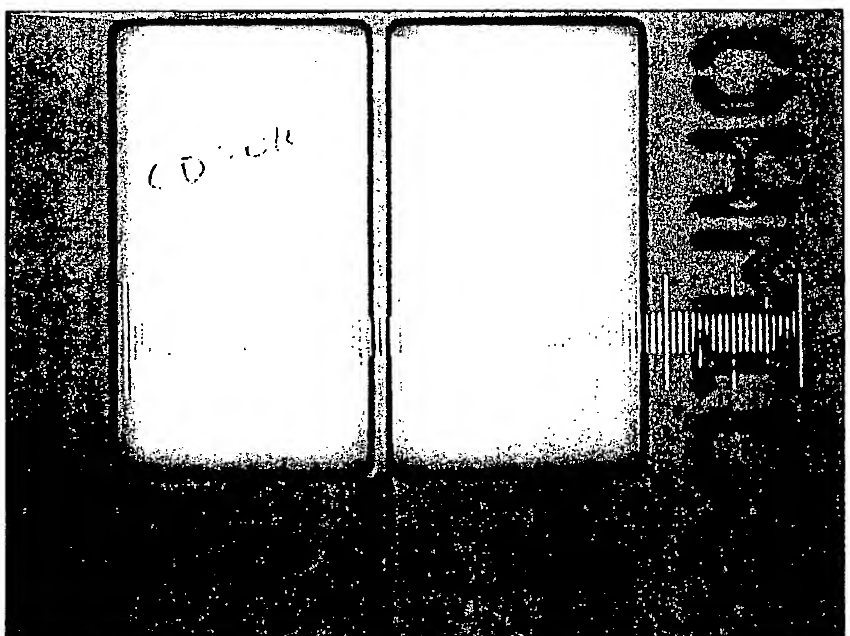
3rd Comp 1
4th Comp 1
5th Comp 1
6th Comp 1

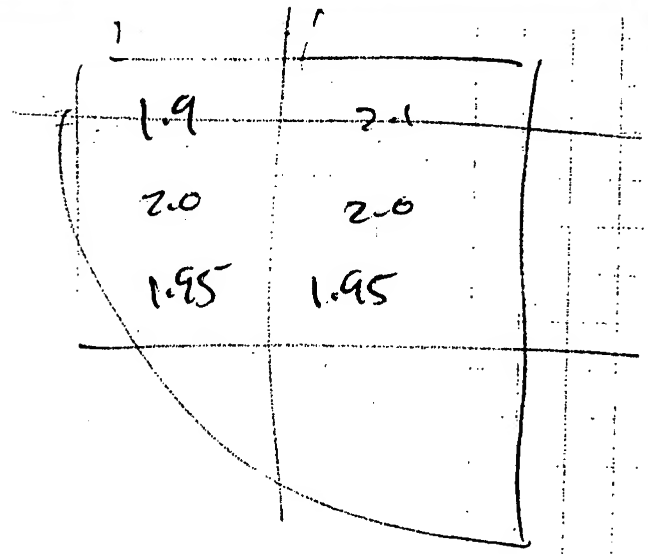
C:\PCI3\IMAGES\PAULGAN\LOT8~1\51279F02.PCI



C:\PCI3\IMAGES\PAULGAN\LOT8~1\51279F03.PCI





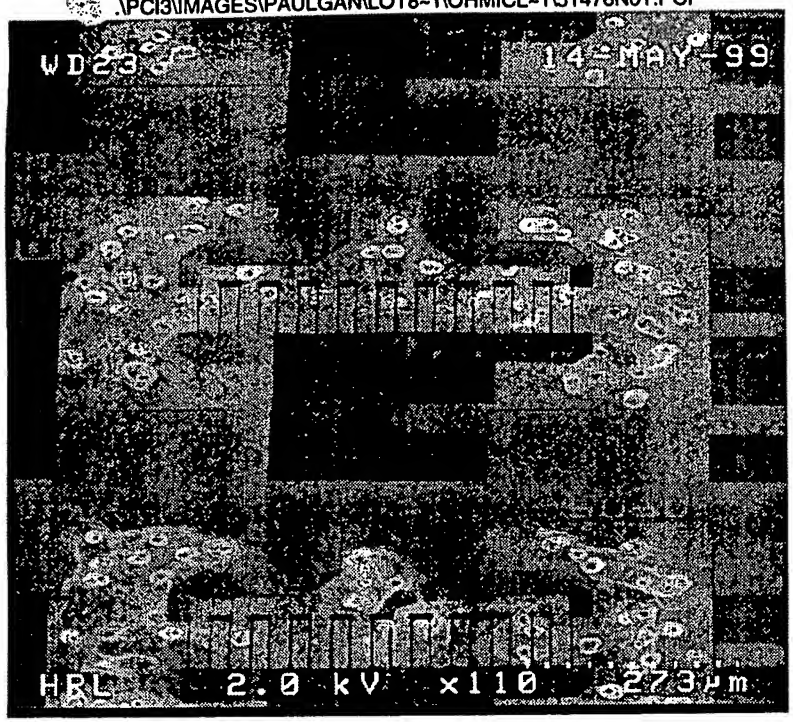


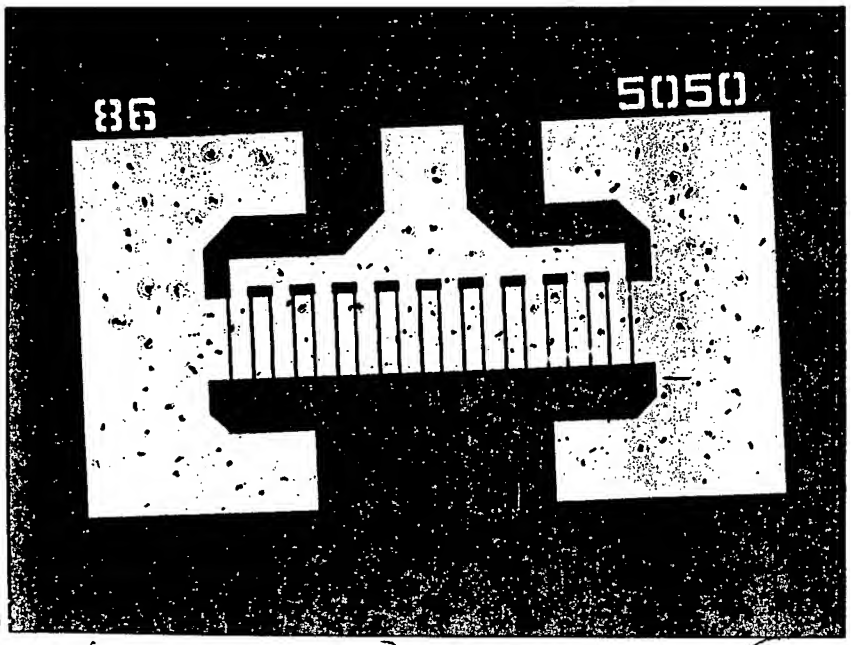
[illegible]

379F [illegible]

379F [illegible]

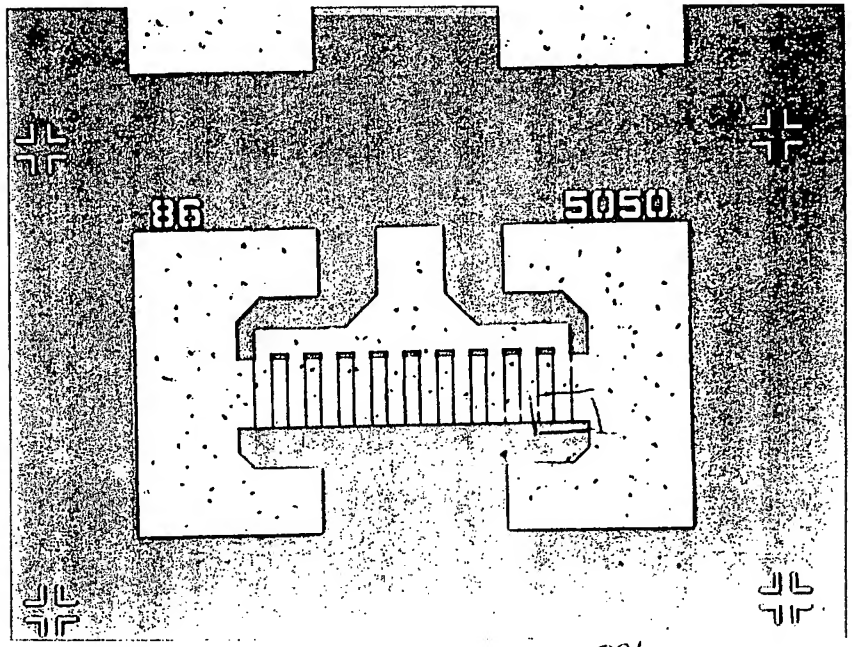
379F [illegible]





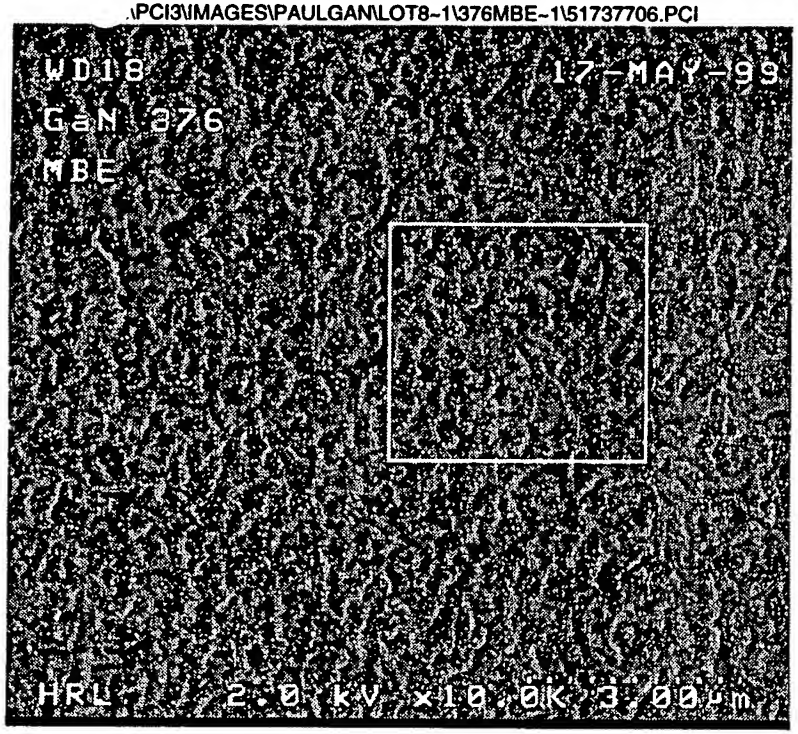
Lots Split

After 30min PR strip 100°C



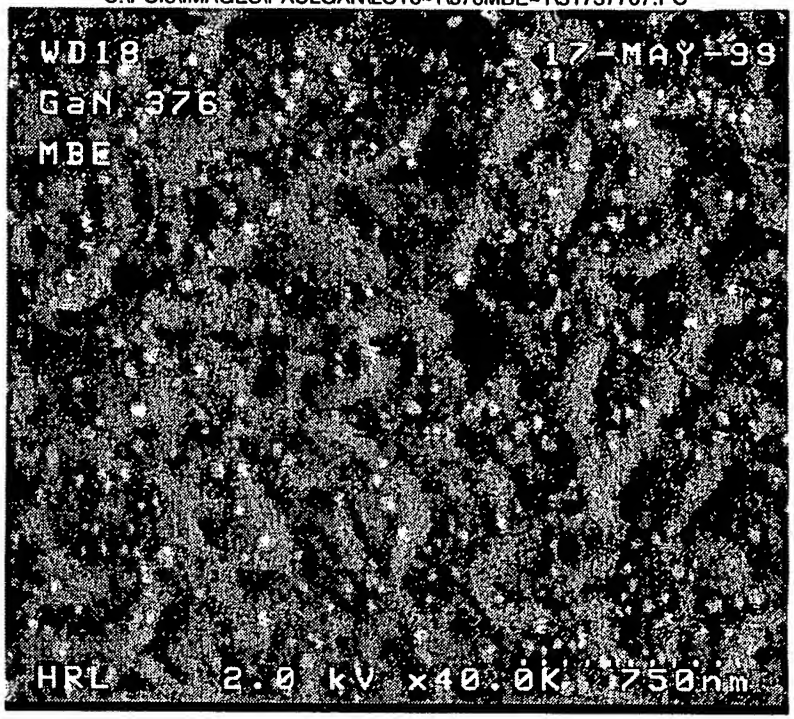
Lot # 376 NF Pulse PRS

.\PCI3\IMAGES\PAULGAN\LOT8~1\376MBE~1\51737706.PCI

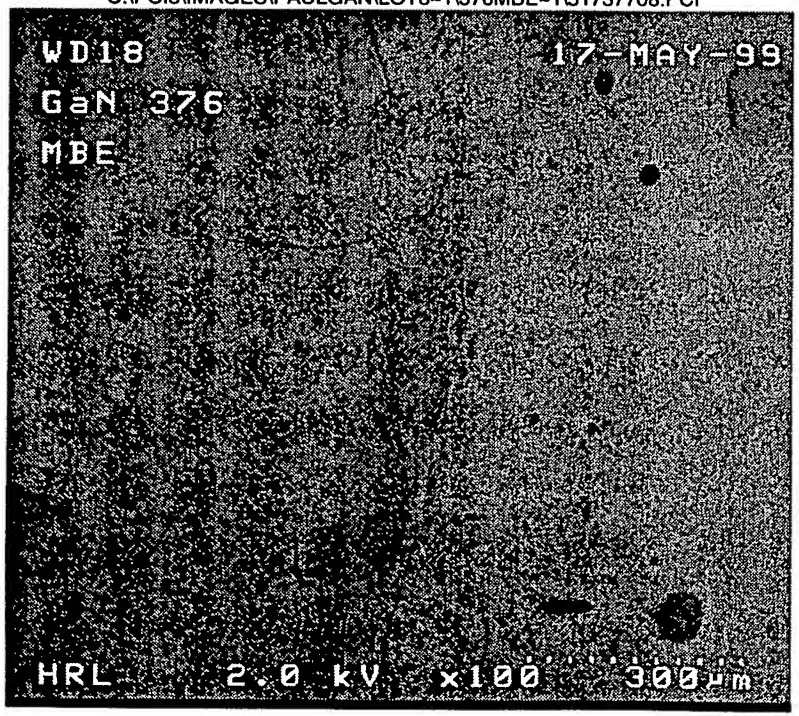


376 more residue

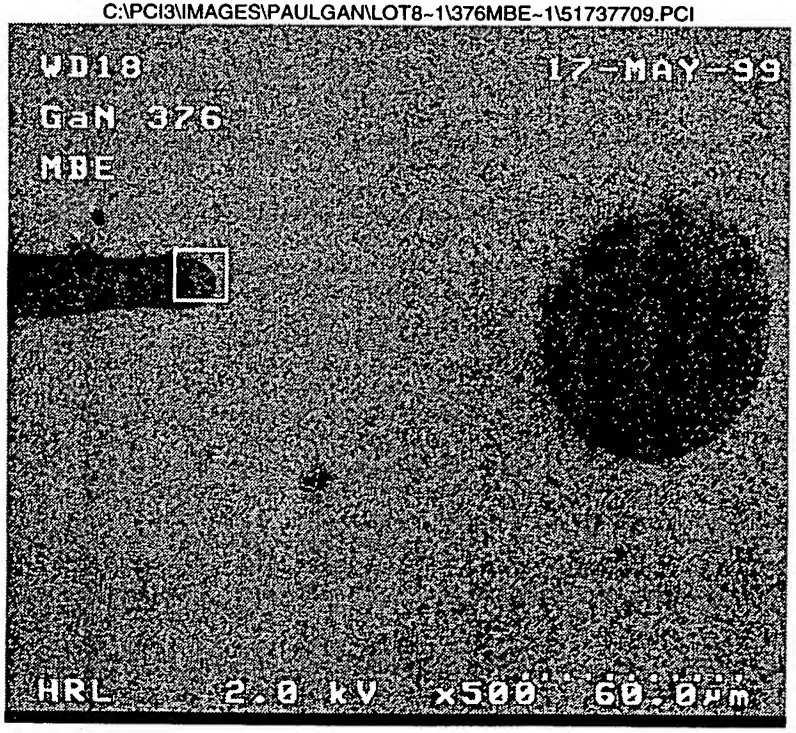
C:\PCI3\IMAGES\PAULGAN\LOT8~1\376MBE~1\51737707.PC



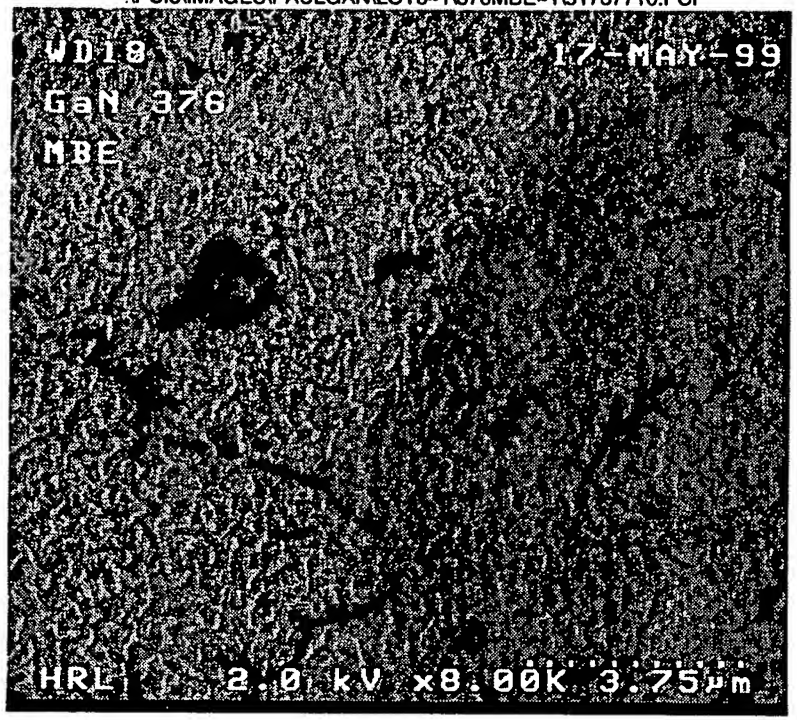
C:\PCI3\IMAGES\PAULGAN\LOT8~1\376MBE~1\51737708.PCI



C:\PCI3\IMAGES\PAULGAN\LOT8~1\376MBE~1\51737709.PCI

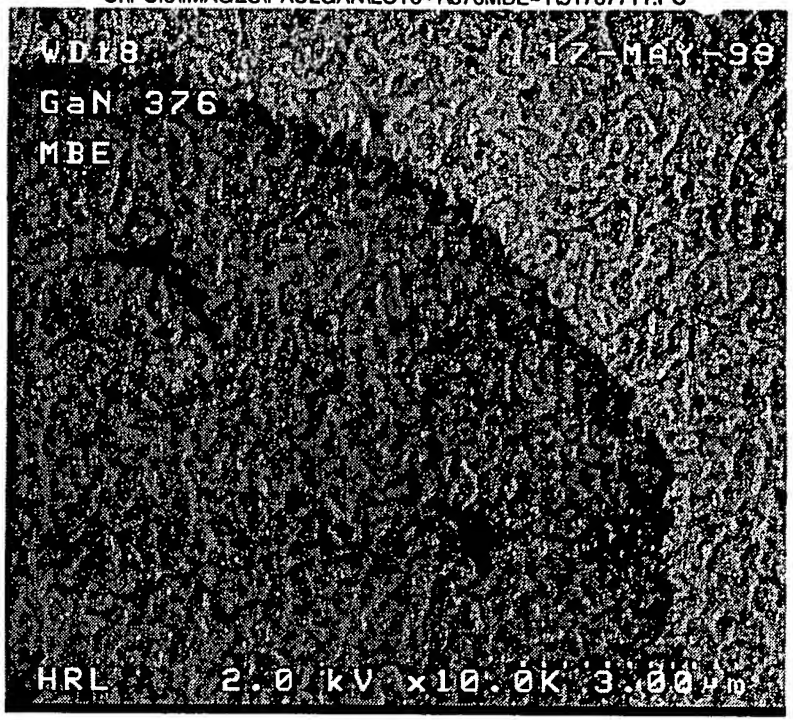


.PCI3\IMAGES\PAULGAN\LOT8~1\376MBE~1\51737710.PCI

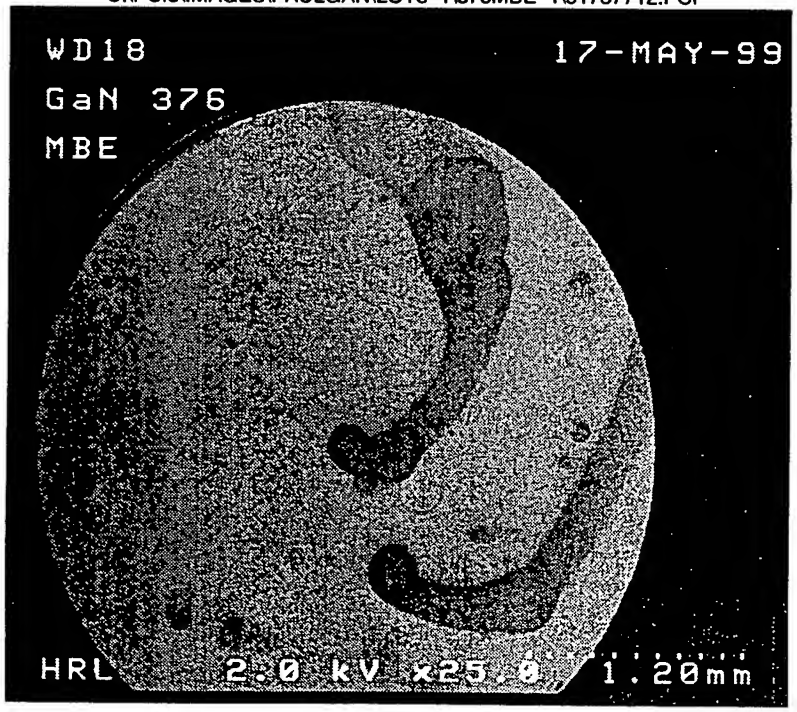


376

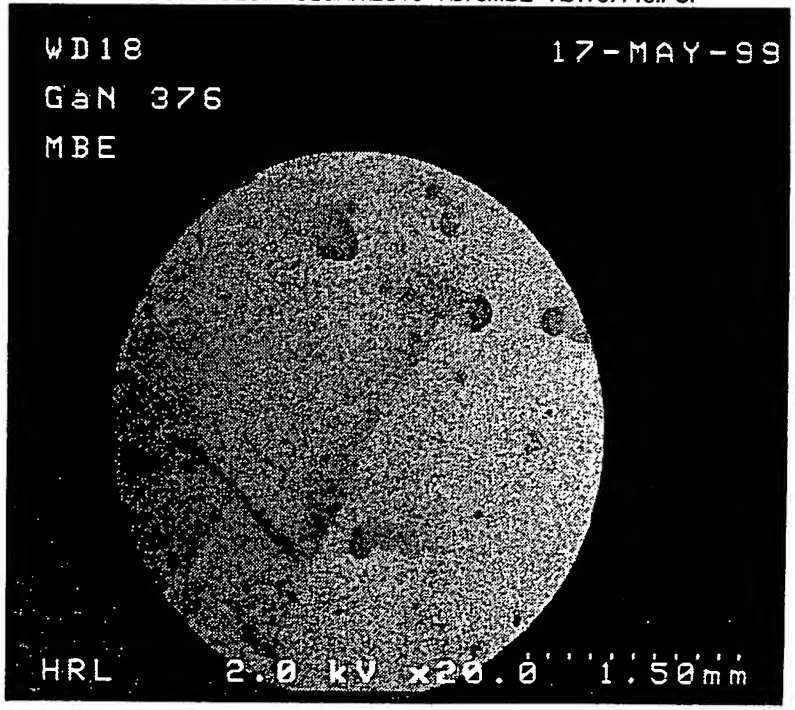
C:\PCI3\IMAGES\PAULGAN\LOT8~1\376MBE~1\51737711.PC



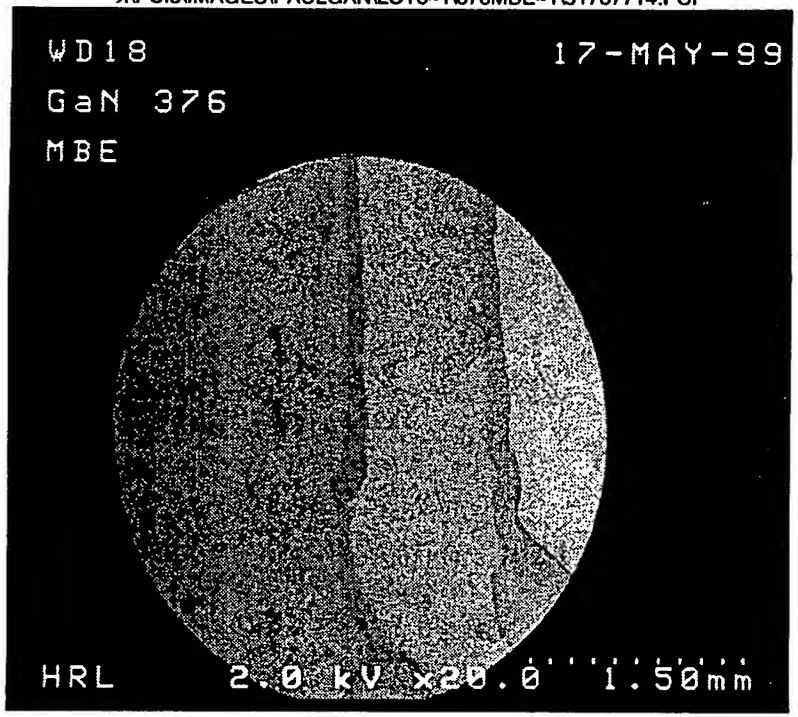
C:\PCI3\IMAGES\PAULGAN\LOT8~1\376MBE~1\51737712.PCI



C:\PCI3\IMAGES\PAULGAN\LOT8~1\376MBE~1\51737713.PCI

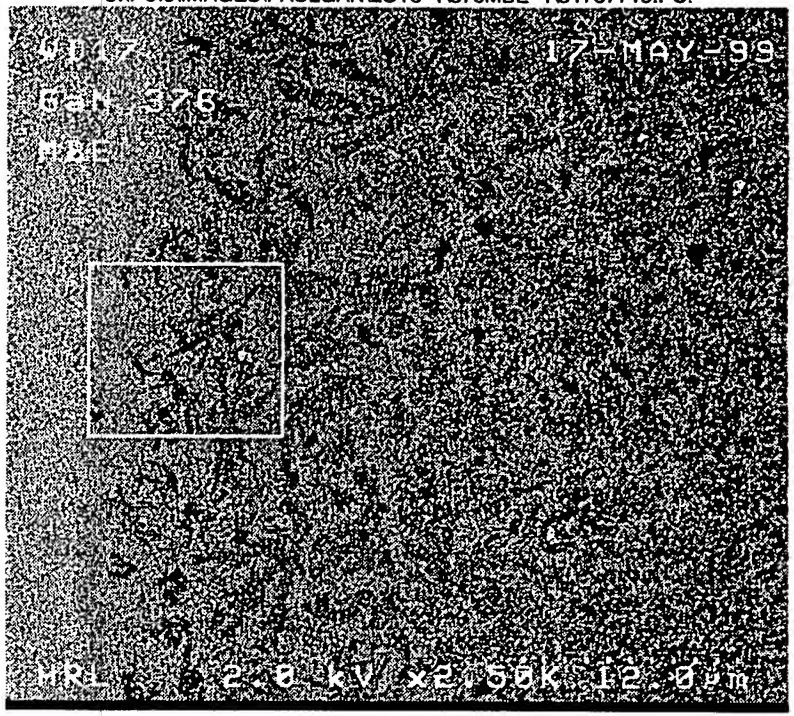


C:\PCI3\IMAGES\PAULGAN\LOT8~1\376MBE~1\51737714.PCI

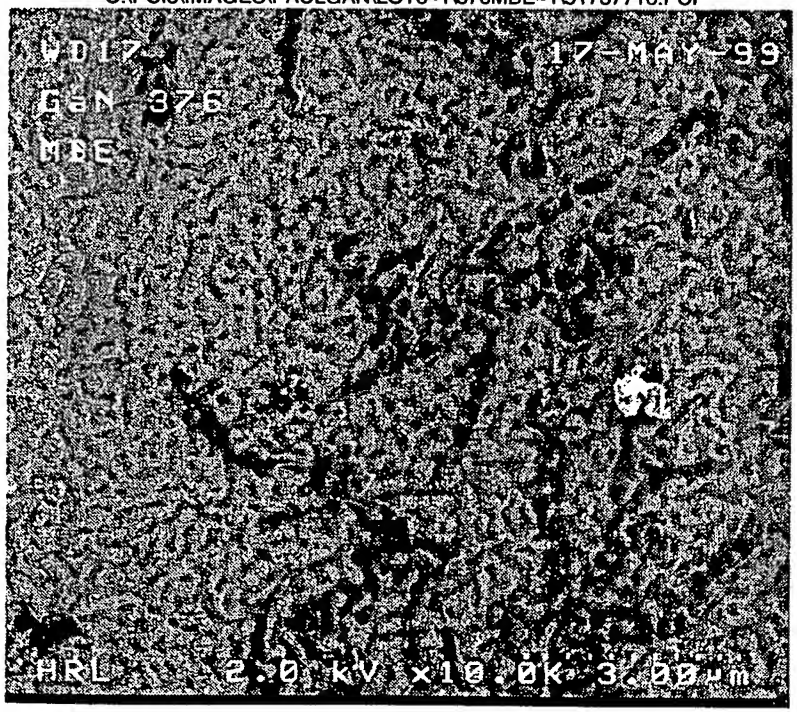


376

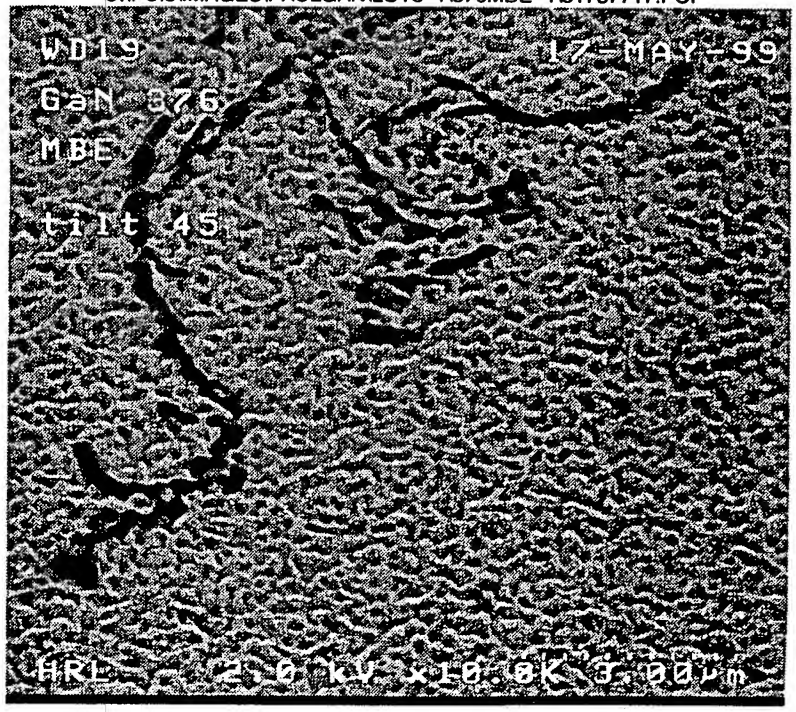
C:\PCI3\IMAGES\PAULGAN\LOT8~1\376MBE~1\51737715.PC.

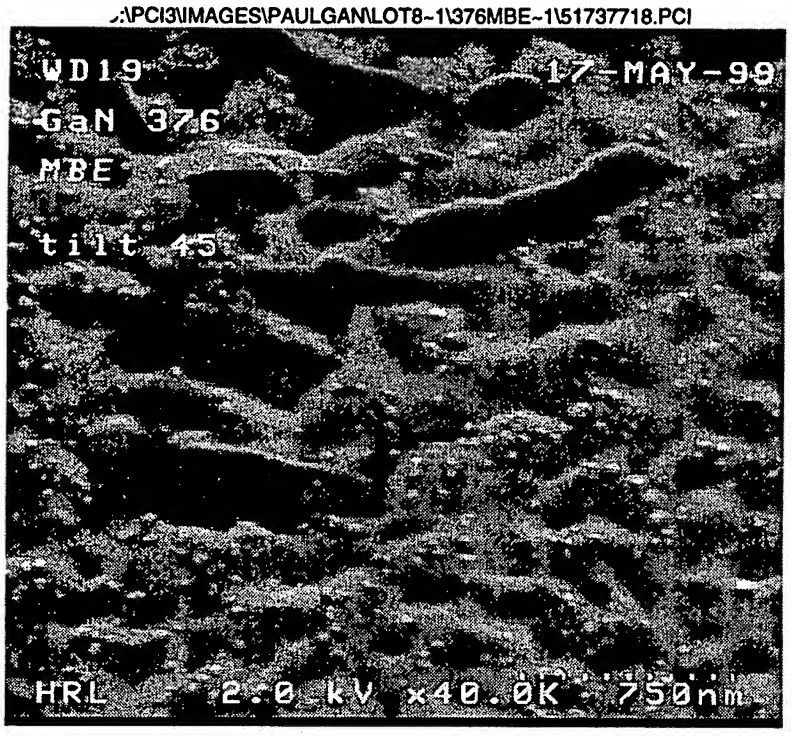


C:\PCI3\IMAGES\PAULGAN\LOT8~1\376MBE~1\51737716.PCI



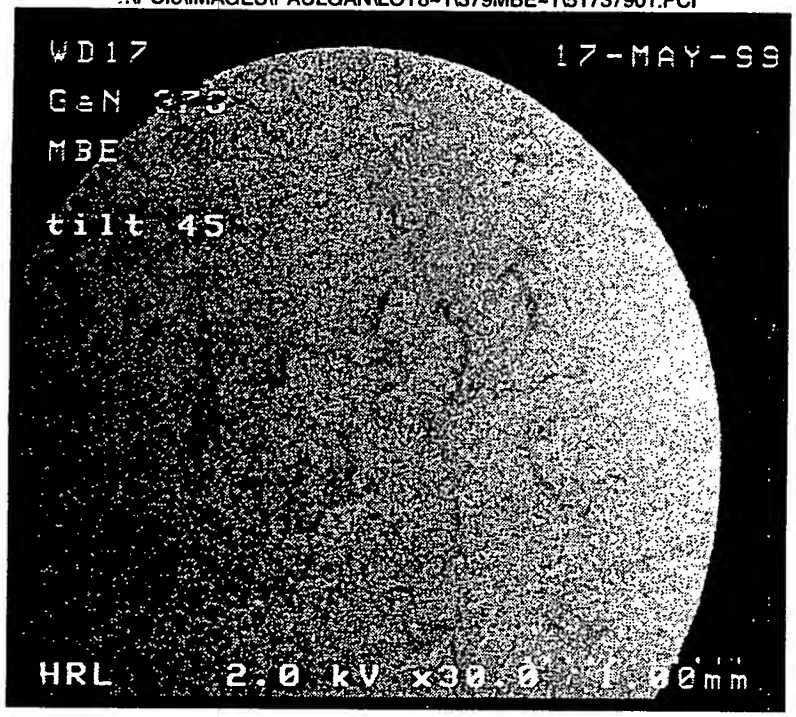
C:\PCI3\IMAGES\PAULGAN\LOT8~1\376MBE~1\51737717.PCI




C:\PCI3\IMAGES\PAULGAN\LOT8~1\376MBE~1\51737718.PCI
WD 19
17-MAY-99
GaN 376
MBE
tilt 45
HRL
2.0 kV
x40.0K
750nm

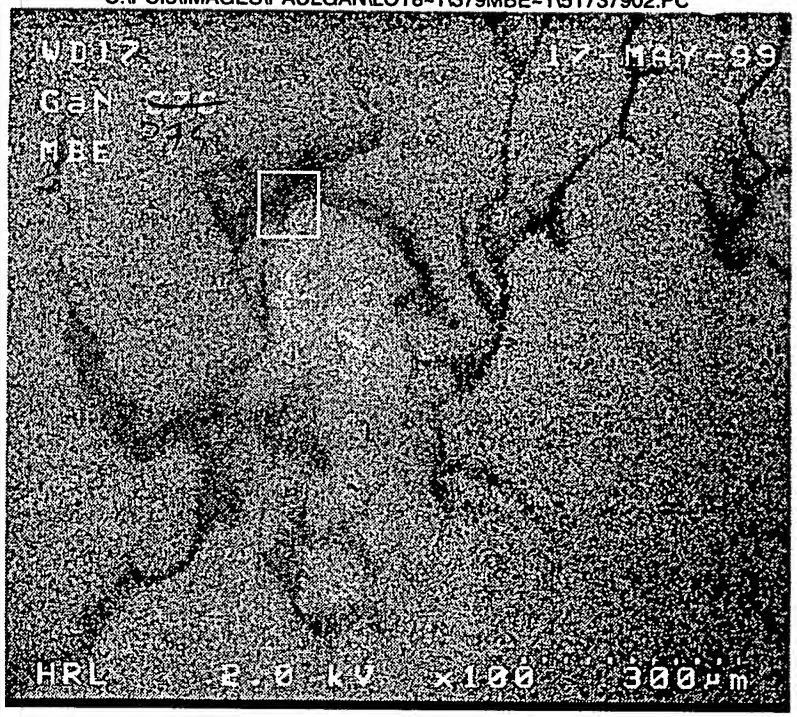
376

..\PCI3\IMAGES\PAULGAN\LOT8~1\379MBE~1\51737901.PCI

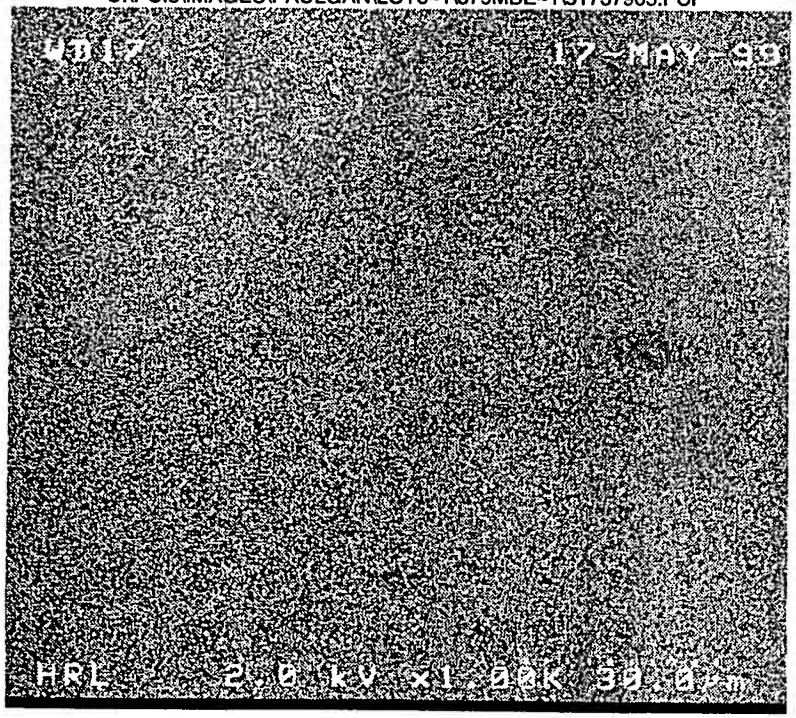


379

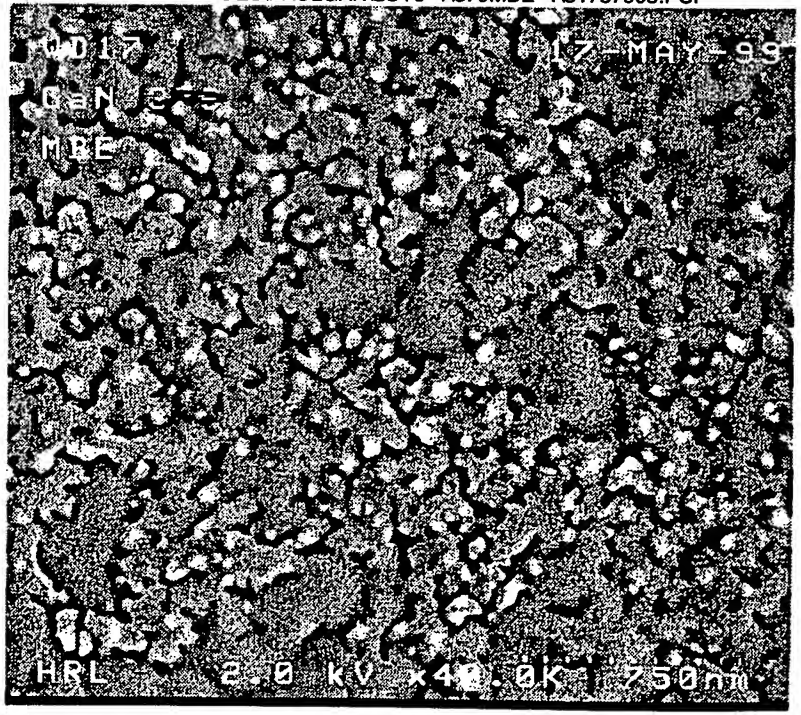
C:\PCI3\IMAGES\PAULGAN\LOT8~1\379MBE~1\51737902.PC



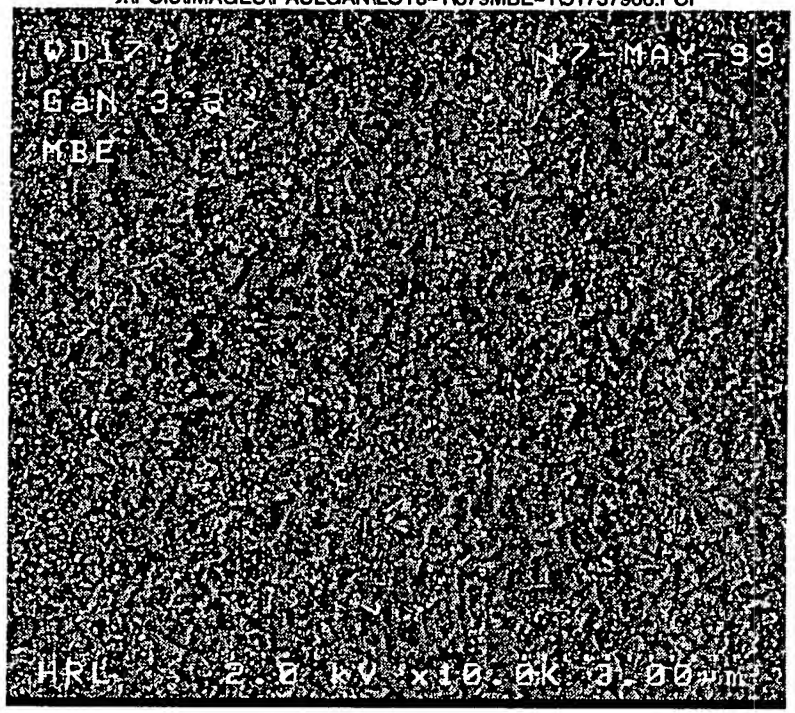
C:\PCI3\IMAGES\PAULGAN\LOT8~1\379MBE~1\51737903.PCI



C:\PCI3\IMAGES\PAULGAN\LOT8~1\379MBE~1\51737905.PCI

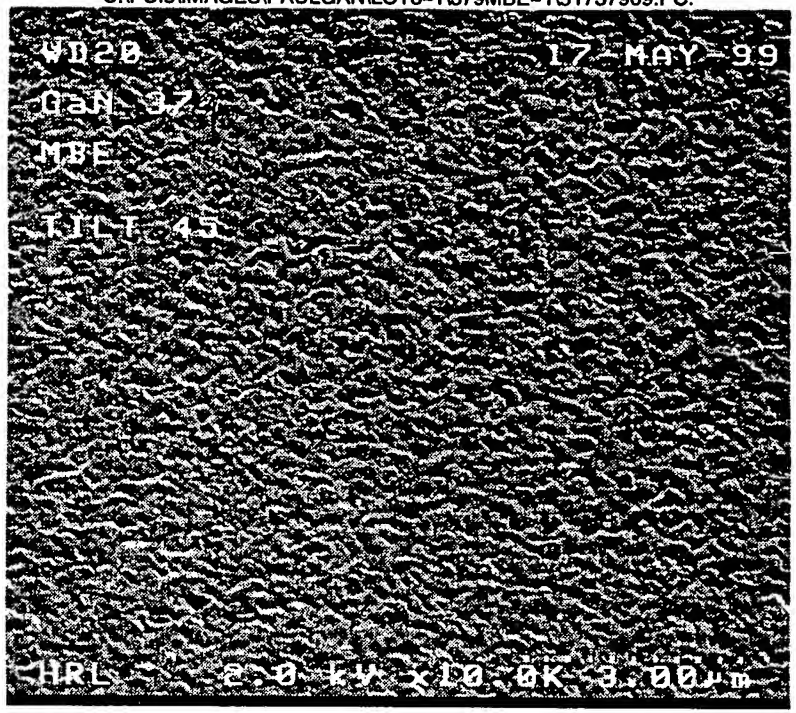


C:\PCI3\IMAGES\PAULGAN\LOT8~1\379MBE~1\51737906.PCI



379

C:\PCI3\IMAGES\PAULGAN\LOT8~1\379MBE~1\51737909.PC.



C:\PCI3\IMAGES\PAULGAN\LOT8~1\379MBE~1\51737911.PCI